INFORMATION CONTENT OF MANAGEMENT FORECASTS: RISK SHIFT AND MEAN EARNINGS SHIFT EFFECTS ON EQUILIBRIUM SECURITY PRICES

BY

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This dissertation is dedicated to the memory of my father,

John J. Gift

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The purpose of this dissertation was to investigate the information content of management earnings forecasts in a mean-variance environment. Specifically, the changes in perceived mean earnings and the variance of those earnings attributable to the release of a management forecast were examined to assess the degree to which each parameter affected security prices in a systematic manner. The analysis used a least-squares regression procedure in order to include both sign and magnitude effects of the two independent variables on security prices, the dependent variable. A traditional partitioned analysis was also conducted to provide a basis of comparison with prior studies.

The experimental sample consisted of 50 management forecasts of earnings released between 1974 and 1979. The dependent variable, security price behavior, was measured as the security residual returns over an 11 week test period centered on the forecast release week. The mean earnings shift was measured as the scaled difference between the management forecast and a financial analyst's forecast available just prior to the related management forecast. The risk shift variable was a ratio measuring the shift in the implied standard deviation over the 13 weeks surrounding the forecast release. The Black-Scholes Options Model was used to generate the implied standard deviation measure.

The results of the regression analysis supported the hypothesis that both mean shift and risk shift effects are impounded in equilibrium security prices. The partitioned analysis provided support consistent with the relevance of both parameters but resulted in statistical significance for the mean shift parameter only.

CHAPTER I
INTRODUCTION

Forecasts of annual earnings have received considerable attention in the accounting literature in recent years. Numerous studies have been done on the issue of forecast accuracy (McDonald [1973], Copeland and Marioni [1972], Basi, at el [1976], Barefield and Comiskey [1975], and others). Additional work has been done in attempting to assess the information content of these forecasts by analyzing the corresponding security market behavior (Foster [1973], Patell [1976], Jaggi [1978], Penman [1980], Beshara [1981] and others). In general, this body of literature supports the hypothesis that earnings forecasts made by company management do have information content as measured by shifts in security returns distributions. However, most of this research has limited the study of these shifts to changes in the expectation of earnings (or earnings per share). The purpose of this dissertation is to investigate the information content of management forecasts considering changes in both the expectation of earnings per share as well as changes in the perceived riskiness (variance of returns) of the security as a result of the forecast.

As a first step, management forecasts should be well defined and distinguished from other "forward looking" information. Numerous types of forward looking information are continuously entering the market place. Macroeconomic information in the form of indicators, projections, and the like, are generated from both public and private institutions. A large volume of firm specific information is also generated as casual observation of any business periodical would support. This firm specific information is primarily generated from two sources, the firm itself and the financial analyst community, and may take the form of quantitative or qualitative data. Management forecasts of earnings, the subject of this dissertation, are a subset of the quantitative, firm specific, forward looking information provided by the firm, not the analyst community. In a strong-form efficient market setting, no rationale would exist to support any distinction between forecasts generated by the firm and forecasts generated by analysts since this form of market efficiency supports the market's ability to know, or at least unbiasedly infer, the content of any insider information. However, current literature is able to support only the semi-strong form of market efficiency. This form does allow that a subset of all relevant information may be known only by firm insiders. As such, analysts at any point in time may possess knowledge of all

public information but not of any inside information. Management, however, has access to all public information and is also in possession of the inside information. The act of releasing an earnings forecast could then convey an element of information to the market that it was not able to discern from similar analyst forecasts. Management's incentives to provide such information may vary from institutional pressures to established firm policy (the latter is quite rare). Although the issue of management incentives may generate some interesting questions, the focus of this dissertation is the impact of this information, not the incentives to produce and release it.

It is important that the term "information content" be clearly defined. A general definition would ascribe information content to any datum that affects the probability distribution about a given variable (Lev [1969]). Gonedes (1975) states that

> one can infer that Θ (the random variable containing information) has information content in the sense that some realizations of Θ induce probability reassessments . . . one can infer that Θ has information content when the distribution function of any security's returns is affected by the information conveyed by Θ (p. 221-2).

Lev views information content as

> . . . a function of two sets of probabilities, one before the reception of the message and one after it. Thus knowledge of the changes in the probabilities permits measurement of the amount of information contained in the message that introduced these changes (p. 1).

Measurement of the changes in the probability distribution has typically been confined to the first two moments of the distribution, i.e., mean and variance. Thus changes in the distribution of a variable H due to the information θ could be reflected as either

$$E(H|\theta) \neq E(H) \tag{1.1}$$

or

$$Var(H|\theta) \neq Var(H) \tag{1.2}$$

or both. This combined mean and variance characterization is the one used in this dissertation.

Certain assumptions, common in the finance literature, are made to derive the parameters of concern to investors. It is assumed that investors possess a quadratic utility function, with an increasing utility of wealth and a decreasing marginal utility. This function may be presented as:

$$U(r) = r + Br^2 \tag{1.3}$$

where r is a random variable denoting return on investment, B is some negative coefficient, and U(r) denotes the utility of r. (See Appendix A for a complete derivation of the quadratic utility equations in this section.) The expected utility is then a function of the first two moments:

$$EU(r) = E(r) + B\,[E(r)]^2 + B\ \mathrm{var}(r) \qquad (1.4)$$

It is apparent that expected utility will increase as expected return increases. Since B is negative, expected utility decreases as the variance increases. An investor whose utility criterion for determining the efficiency of his investments is quadratic may alter his efficient set as a result of changes in $E(r)$ and/or $\mathrm{var}(r)$. It follows that both investor utility and resource allocation are subject to shifts in these important parameters.

Because $E(r)$ and $\mathrm{var}(r)$ are parameters of concern, some linkage must be developed between earnings per share (EPS) numbers and these market parameters. The following general present value model with a constant dividend payout ratio will be used:

$$d = (1-b)\ I_1 \qquad (1.5)$$

where d is the dividend in period one, I is the earnings or income in period one (assumed constant over all periods if, in every period, all earnings are paid out in dividends), and b is the percentage of earnings retained by the firm for internal financing ($0<b<1$). Given this situation, earnings for period two are

$$I_2 = I_1 + GbI_1 \qquad (1.6)$$

where G is the return which the firm can generate on any

earnings retained. Therefore, the dividend in period two is

$$d_2 = (1-b)\ I_1\ \ (1+Gb) \qquad (1.7)$$

As this retention effect continues over the periods of a firm's existence, the dividend in the n^{th} period may be stated as:

$$d_n = (1-b)\ I_1\ (1+Gb)^{n-1} \qquad (1.8)$$

If we assume that a security is priced at the present value of all future dividend flows, then a firm of indefinite life would have its stock valued as:

$$P = \sum_{n=1}^{n} \frac{d_n}{(1+k)^n} = \sum_{n=1}^{n} \frac{(1-b)\ I_1\ (1+Gb)^{n-1}}{(1+k)^n} \qquad (1.9)$$

where k is the investors' required rate of return. This valuation formulation can be simplified to:

$$P = \frac{(1+b)\ I_1}{k - bG} \qquad (1.10)$$

It follows from the above model that security prices can be viewed as some linear function of the future

earnings of the firm. These prices, along with dividends, are used to state the market return as:

$$r = \frac{P_1 - P_0 + d}{P_0} \tag{1.11}$$

Equation (1.10) can be substituted for the prices in (1.11), resulting in:

$$r = \frac{\dfrac{(1+b)\ I_2}{k - bG} - \dfrac{(1+b)\ I_1}{k - bG} + d}{\dfrac{(1+b)\ I_1}{k - bG}} \tag{1.12}$$

New information concerning management's expectations of future earnings may alter the end of period market expectation of earnings, I_2, resulting in I_2' where I_2' is unequal to I_2. It is obvious, from equation (1.12), that the market return over a given period will shift from its initial level in the same direction that I_2 shifts. This argument forms the basis for expecting positive (negative) abnormal market returns to accompany unexpected positive (negative) revisions in earnings.

Quite often a present value model is presented under conditions of certainty. Yet, in the earlier presentation of the quadratic utility function, it was determined that the riskiness of an investment is also an important parameter of interest. Uncertainty can be easily introduced into this present value model. Two common methods of accomplishing this are: 1) to adjust the discount rate used to account for the risk incurred, i.e., to use a risk adjusted discount rate, or, 2) to directly adjust the variable about which the uncertainty exists, in this case earnings, by establishing a certainty equivalent. Using the certainty equivalent approach, it can be said that:

> in general, for an individual with a strictly concave utility of wealth function (quadratic utility function is of this class), the certainty equivalent level of wealth associated with a given probability distribution <u>is always less than</u> the expected value (no risk adjustment) of wealth associated with the distribution. (Fama and Miller, 1972, p. 202)

This is expressed as:

$$CE = u - hd \tag{1.13}$$

where CE is the certainty equivalent, u is the expected value, d is the variance around that expected value, and h is the certainty equivalent factor where h>0 for any risk averse investor. As such, shifts in the market's

perceived variability around an earnings number are expected to affect the firm's security prices and returns.

Given the behavior of certainty equivalents and the present value model in equation (1.12), a relationship between risk effects and market returns can be developed. If the release of some information leads an earnings stream to be perceived as more risky, its certainty equivalent will be reduced, so that $I_{2,CE}<I_2$ where $I_{2,CE}$ is the certainty equivalent of the expected earnings after considering the increased risk, and I_2 is the expected earnings prior to the introduction of the increased risk. This will result in a lower end-of-period security price and thus result in a lower return over the period than would have been realized in the absence of a shift in risk. In essence, a negative relationship will exist between changes in risk and the corresponding changes in market returns.

The question arises: is it reasonable to hypothesize that the release of new information (such as a management forecast) will impact only the mean expectation of earnings and have no effect on the variance (risk) around that expectation? The answer is: probably not. Hence, the alternative proposition is that an information release may induce both a mean shift effect and a risk shift effect. Table 1-1 presents the relationship between firm equity returns and the market's mean and variance

Table 1-1

Impact on Stock Returns Given
Type of EPS Forecast

		Changes in EPS Variance		
		Decrease	No Shift	Increase
Changes in EPS Mean	Increase	Very Positive	Positive	Uncertain
	No Shift	Positive	No Effect	Negative
	Decrease	Uncertain	Negative	Very Negative

perceptions of the firm's earnings per share. Given that both the mean EPS level and the perceived variance of that figure may impact security returns, both warrant investigation. Implementation of mean EPS effects has been previously studied but the risk effect has not. The question must then be raised, how can the risk shift effect be measured and incorporated into an experimental design?

No evidence currently exists to support or oppose the position that risk shift effects may be induced by new information. This scarcity of "risk shift effect" considerations in security based information content research may be the result of a lack of appropriate operational measures for incorporating the possible risk shift phenomenon in empirical tests.

The purpose of this paper is to investigate the information content of management forecasts considering both the mean shift and the risk shift dimensions. A new methodology, using the Black-Scholes Options Model, will be used to implement risk shift considerations--the primary contribution of this study.

Chapter II provides a literature review of the relevant research. This review looks at the literature related to the management forecast issue. A concise literature review of the development and tests of the Black-Scholes Options Model is also presented in this

chapter. Chapter II concludes with a review of accounting studies which have used the options model in information content related studies.

Chapter III presents the methodology employed in this study. The independent and dependent variables used are defined and discussed. The statistical tests and operational hypotheses are also presented in this chapter.

Chapter IV presents the results of the tests employed and a discussion of those results. Chapter V concludes this study with a summary of the principal results, a discussion of the limitations of the study, and suggestions of possible avenues for future research.

CHAPTER II
REVIEW OF RELEVANT LITERATURE

This section presents the results of previous research concerning the following topics: forecast accuracy and stock price reactions, options model development and tests, and use of the options model in accounting studies.

Early Research in Forecast Accuracy

Management forecasts first became of interest in studying the question of relative accuracy. Green and Segal (1967) introduced this area in a study which developed as an empirical aspect of the theory of interim reporting as presented by Green (1963). The major component of this study addressed the accuracy of analysts' forecasts relative to mechanical forecasting models. Almost as an aside, Green and Segal included 12 management forecasts in the latter part of the study and produced casual conclusions regarding their accuracy. It was this aspect of the Green and Segal study which Copeland and Marioni (1972) cited in their replication and extension, focusing on management forecasts. Their main criticisms of Green and Segal were the small sample size

used and the sample selection process. Copeland and Marioni used a sample size of 50 forecast observations and assessed the accuracy of these management forecasts against six different naive mechanical models. Comparisons of the mean relative errors, without statistical tests, did not indicate that management forecasts were superior predictors relative to naive models. However, when ranks of the accuracy were used as the dependent variable, the results supported the intuitively appealing proposition that managers are a better predictor of earnings than naive models.

Accuracy of management forecasts was examined by Basi, Carey and Twark (1976) and by Ruland (1978). Their findings indicated a marginal but not significant difference between the accuracy of management forecasts and analysts' forecasts. In addition, Ruland found management forecasts and subsequent analysts' forecasts to be superior to a naive continuous growth model; however, the analysts' forecasts that preceded management forecasts were not superior to the naive model.

Using a different and slightly larger data set, Jaggi (1980) replicated and extended the Ruland study. He found management forecasts to be superior to analysts' forecasts that preceded them. However, they were not superior to analysts' forecasts that followed them. This is consistent with the logic that the information in the

published management forecast will be included in any subsequent analysts' forecast. In addition, Jaggi found that management forecasts were more accurate in industries characterized by more volatile earnings. The overall implication is that management forecasts were more frequently accurate predictors of earnings as compared with forecasts made by naive models and by analysts.

Relationship of Management Forecasts to Stock Returns

In an early study, Foster (1973) investigated the impact of earnings estimates released by management. These were announcements made subsequent to the fiscal year end but prior to the formal announcement of earnings. As such, the data available to management in determining these estimates would be far more extensive and complete than that available to a company officer who releases a forecast at mid-year. Foster confirmed the hypothesis that a market response would occur in reaction to the release of the estimate, supplanting the expected response normally occurring in reaction to the official earnings announcement. He speculated that this replacement effect was due to close proximity of the two announcements and the similar data used to develop each. These estimates do not strictly fall into the category of a forecast. Gonedes, Dopuch, and Penman (1976) addressed the theoretical motivations for management forecasts.

However, since very few management forecasts could have satisfied their data requirements, they conducted their test on analysts' forecasts as surrogates for management forecasts. Their results offer partial support for the information content of earnings forecasts. However, these results should not be generalized beyond the area of analysts' forecasts.

The first direct test of the market effects of management forecasts was conducted by Patell (1976). He used 336 actual management forecast releases between 1963 and 1967. He required his sample to meet a series of restrictions, each designed to minimize contaminating or confounding influences.

Average prediction error and return variance statistics were examined. The week of the forecast was the week of the positive price revision of the greatest significance. Of particular interest is the behavior of the variance statistic before and after the forecast release. Week "minus three" did exhibit a greater than expected variance; but it was not statistically significant. Prior to the forecast release, the variance statistic exhibited a significantly (0.05) low level two out of eight times. Subsequent to the forecast release, six of eight observations of the variance statistic show a significantly low level. The variability of returns was affected, on average, by the forecast release. Patell

stated that "the period immediately following the price revisions at the date of the forecast disclosure was one of very low (firm-specific) variability in rates of return" (p. 261), and did not address the issue any further. Since both return and risk are relevant parameters of interest to the investor, this variability effect warrants further investigation.

In regard to the prediction error, the null hypothesis that the expected value of this error is zero during the week of the forecast release was rejected at a significance level below 0.01. The null hypothesis could not be rejected in other weeks. Furthermore, the level forecasts were accompanied by a stronger market response than the point forecast.

Because a large portion of the sample was composed of utilities (52 of 336 observations), which are affected by the regulatory environment, the sample was partitioned and the analysis was conducted for utilities and non-utilities. The non-utilities exhibited a highly significant prediction error and Kolmogorov-Smirnov statistic. Utilities, on the other hand, showed a non-significant prediction error, although their Kolmogorov-Smirnov statistic was significant at below the 0.05 level.

The timing of the forecast release provided mixed results. First and third quarter releases yielded

statistically significant results, but the second quarter releases did not. No reason was offered for this anomaly. It is interesting to note that forecast information released alone appears to have had a stronger impact than forecasts released at the same time as interim earnings information. Forecasts released in isolation can be clearly evaluated as to the nature of the news; but, when forecasts are released with other information it is difficult to evaluate the forecast component of the joint effect.

The study then investigated the extent to which the forecast information impacted market expectations. Three naive models, one martingale and two sub-martingales, were used as surrogates for the market expectation of earnings. The forecast variable was measured as the scaled difference between the forecast and the naive models. The observations were partitioned into quartiles on the basis of this measure. Of the twelve portfolios formed (three models x four quartiles) all exhibited significant positive returns effects in the week of the forecast, in spite of the fact that three of the twelve portfolios were composed of exclusively negative information forecasts.

Patell's study provided interesting insights into various facets of the forecasting effect. His choice of a naive expectations model is consistent with similar research but such a model may lack validity, and this fact

may explain why the results of his study are occasionally mixed. Questions raised by this study which have not been adequately addressed in subsequent literature include the following. Does a systematic difference exist between point and level forecasts? Is the information impact contingent on the time of the release? Can a risk effect be discerned as an aspect of the information effect? The last question is pursued as a major portion of this dissertation.

Two particular aspects of prior research motivated another study by Jaggi (1978). In the Foster study (1973), which examined managements' estimates of annual earnings, there was a very short interval between the release time and the actual earnings announcement. Jaggi contended that most of this information might already be in the market, and he proposed to study only forecasts made at least eight months prior to the end of the fiscal year. Secondly, Jaggi argued that the weekly returns data used in the Patell study might have distributional problems, and proposed to use daily data. The null hypothesis tested was "management earnings forecasts do not provide additional information to investors causing them to revise their expectations around the announcement date" (p. 962).

On his sample of 154 earnings forecasts for 121 firms, Jaggi tested the daily residual for each firm for statistical significance at the 0.05 level for each day in the 21 day test period surrounding the forecast. Unusual price revisions occurred around the forecast day indicating that "disclosure of management forecasts may have caused investors to revise their expectations" (p. 964).

Jaggi also tested for anticipatory stock price behavior related to the forecast news in the form of deviations from naive models. He concluded that a price adjustment did occur over the 21 day test period. Additionally, Jaggi's findings supported the notion of an announcement effect. Both of these effects were previously noted by Patell.

Nichols and Tsay (1979) sought to assess the impact of long-range management forecasts. In light of Foster's and Patell's studies using exclusively, or partially, forecasts of a short range, Nichols and Tsay focused their study exclusively on forecasts made six months or more prior to a firm's fiscal year end. (It should be noted that the Nichols and Tsay study was completed and accepted for publication prior to the publication of the Jaggi study.) Nichols and Tsay's data were composed of 83 forecast observations over the period 1968 to 1973. The

relatively small data base was due, in part, to the inclusion of only long-range forecasts and a strict set of criteria established to minimize the effect of "other information".

Their results indicated an average residual that was largest in the forecast week, but not significantly larger than any other week. The relative rankings across firms were compared, and week zero did not appear to dominate other weeks with regard to the size of the residual. Nichols and Tsay concluded, from inspection of the data, that the larger average residuals in week zero are likely to be the result of a small number of firms with a strong market response. While supporting the premise that any overall announcement effect was primarily driven by the market response of those firms with high forecast information, Nichols and Tsay stated that "no significant difference between the medians of the four groups" (p. 151) was observed across groups partitioned on the size of the forecast information variable.

Penman (1980) investigated the information content of forecasts by addressing two areas: the first was the full disclosure issue and the second was the information content issue. In regard to the full disclosure issue, Penman's purpose was to "discover whether voluntary forecast disclosure results in the publication of only a

subset of earnings forecast information potentially available from all firms" (p. 134).

Empirical analysis of the full disclosure question required the partitioning of the data set according to earnings effects and forecast effects. The partitioning established two levels for each of the two factors (2x2), resulting in four portfolios. After risk-equalizing the returns of the four portfolios, a T^2 analysis was performed as a joint test of differences between all four portfolios. The T^2 analysis indicated that significant differences existed, in some manner, between the four portfolios. Univariate analysis indicated that the portfolio of high earnings and high forecast had a mean return over the year greater than any other portfolio and significantly different from zero. The opposite portfolio, low earnings and low forecast, exhibited the lowest mean return of the four portfolios. However, this mean return was positive, albeit not significantly different from zero.

Penman concluded that his "results suggest that voluntary forecast disclosure does not result in the full disclosure of earnings forecasts available from all firms" (p. 150). Two factors must be carefully considered in evaluating this conclusion. First, Penman stated that "the tests depend critically upon a correct specification of the aspect of potential signals that are relevant to

the character affecting firm value" (p. 137). He then defined the difference between the earnings expectations generated via a single naive model and the announced number (earnings or forecast) to provide that correct specification. This placed the "critical" dependency on the appropriateness of a single naive model. If the naive model used was not appropriate, misclassification may have occurred. Secondly, the use of the market returns over the calendar year containing the forecast as the dependent variable could have induced additional noise. This would be the case for any firm issuing a forecast prior to the latter part of the year since the months subsequent to the forecast, for which no particular expectation can be hypothesized, are included in the variable. These aspects could impact the observed results and bring into question the validity of the stated conclusion.

Penman also found that positive (negative) forecast releases were accompanied by positive (negative) cumulative excess returns. This relationship was particularly evident in the days immediately surrounding the forecast release. He concluded that "the results of the excess returns test indicates that information is actually conveyed to investors by the forecast announcement" (p. 157).

The final study directly related to voluntary forecasts was conducted by Beshara (1981). This study

addressed four questions: First, do earnings forecasts convey new information to the market? Second, does the act of releasing a forecast convey favorable information? Third, is the market reaction to a voluntary forecast related to both the information in the forecast and to the implied accuracy of that forecast? And fourth, do forecasts made by a given firm convey information concerning non-forecasting firms in the same industry?

Beshara analyzed the standardized residuals of 401 experimental firms in an attempt to uncover an announcement effect. Inspection of standardized residuals and analysis of variance over the seventeen-week test period failed to suggest the existence of a positive announcement effect.

The remainder of the study required some measure of pre-forecast earnings expectations against which the forecasted number could be assessed in order to measure the new information in the forecast. Instead of relying on mechanical models, Beshara used analysts' forecasts released prior to the management forecast as his expectations measure. Numerous studies had indicated that analysts' forecasts were not inferior to naive models. Beshara also used analysts' forecasts in measuring "imputed accuracy". He measured this as the degree of change occurring in analysts' forecasts from before to after the release of a management forecast.

Beshara first addressed the impact of the direction of the forecast. Three portfolios were formed based on the relative difference between the management forecast and the previous analyst' forecast. Positive, neutral and negative forecast portfolios were formed. Both a partitioned analysis and analysis of variance indicated a positive (negative) returns shift accompanying the positive (negative) forecast portfolio.

In regard to imputed accuracy, Beshara concluded that high (low) imputed accuracy is accompanied by strong (weak) security price reaction. The support for this conclusion is not strong. Negative news firms, in particular, present mixed results in the weekly standardized residuals. Any conclusions regarding the impact of imputed accuracy must be considered tentative.

The final question addressed was the degree to which the information of a given firm's forecast affected the industry to which that firm belonged. A set of industry matched firms was used as the experimental set in this analysis. Analysis of the residuals indicated that an industry effect seemed to follow the release of a negative forecast, but not a positive forecast. Beshara indicated that the relatively small sample size may have clouded the results of this analysis.

Considering the literature cited above, the majority of empirical evidence supports the contention that

management forecasts do contain security price relevant information. Only one of the studies reviewed, Nichols and Tsay (1979), did not support this premise, although a portion of their analysis pointed to this conclusion.

Three major issues are addressed in this set of studies: the issue of announcement effects, the full disclosure issue, and shifts in security equilibrium prices (the information content issue). Virtually every study addressed the issue of the announcement effect in some manner, resulting in conflicting results across studies.

The full disclosure question was addressed only in Penman's study. Although certain methodological weaknesses were cited, the introduction of this perspective and the development of a methodology to pursue it are significant contributions. Although Penman concludes that "full" disclosure does not, apparently, occur, this issue should not be considered resolved.

The final question, information content, is the one of interest to this study. The studies cited considered this question strictly from a perspective of the security response to a new EPS expectation. Yet, Patell (1976) did note a reduction in the cross-sectional price volatility following the release of a management forecast. This should at least raise the question of what effect the forecast release has on the market's perception of the

riskiness of a given security and to what degree does this affect the security price response?

This dissertation seeks to investigate the second part of the above question. Recall that both risk and return are relevant security price parameters, as discussed in Chapter I. Existing literature has investigated security price behavior as related to mean shifts in EPS without considering any aspect of shifts in the variance accompanying that forecast release. If, in fact, this second parameter is relevant, then an important element of the security pricing mechanism has been neglected in prior studies. An examination of the response of security prices to both mean shifts and variance shifts may yield additional insights into the information content question.

Additionally, extant research has not fully investigated the relationship between the magnitude of the new information in a forecast and the magnitude of the market response. In many of the tests used, the actual value of the forecast information metric was converted to some factor level, thus causing a potential loss of information. If the sign of the forecast information is related to the sign of the prediction error, it seems reasonable to assume that the magnitude of the forecast information may be related to the magnitude of the prediction error. Hence, a continuous measurement scale

is utilized in this dissertation to minimize information loss.

The two points presented above form the basic research questions addressed in this dissertation. First, and of primary interest, are both the forecast information (mean shift) and the risk shift experienced over the forecast period relevant security price parameters? Second, are both the sign and magnitude of these independent variables significant characteristics? In order to investigate the first question, the options model is used as the vehicle to measure the risk shift phenomenon. A brief review of the options model is provided below.

The Options Model - A Risk Measurement Tool

Black and Scholes (1973) derived an options pricing formulation which can be used to calculate the equilibrium price of an option given the following assumptions:

1) there are no penalties for short sales,
2) there are no transactions costs or taxes,
3) there is a continuous market,
4) there is a constant risk-free rate,
5) no dividends are paid,
6) the stock price is continuous, and
7) the option can only be exercised at maturity.

The model is stated as follows:

$$W = XN(Z_1) - Ce^{-rt}\, n(Z_2) \qquad (2.1)$$

$$\text{where: } Z_1 = \frac{\ln (X/C) + (r + 1/2\, v^2)}{vt^{1/2}}$$

$$Z_2 = Z_1 - vt^{1/2}$$

W = the current option price for a single share of stock.

X = the current stock price.

C = the exercise price of the option.

e = the base of the natural logarithm.

t = the time until the option expires.

r = the constant continuous risk free rate of interest for period t.

v = the standard deviation of the stock's rate of return.

Merton (1973) then extended this model to include a continuous dividend yield. Although this assumption (continuous dividends) is not realistic, Merton felt that capturing the dividend effect in some manner was preferable to ignoring it.

The Merton formulation follows:

$$W = e^{-yc} XN(D_1) = e^{-rt} CN(D_2) \qquad (2.2)$$

where: $D_1 = \dfrac{\ln (X/C) + (r - y + 1/2\ v^2)}{vt^{1/2}}$.

$D_2 = D_1 - vt^{1/2}$

y = the continuous dividend yield.

Note that when the dividend rate is set equal to zero, the Black-Scholes formulation and the Merton formulation are equivalent. In regard to the options model in general, it is important to note that the knowledge of investors' attitudes toward risk is not required; therefore, no assumption needs to be made concerning investor utility functions. Also, all inputs are directly observable, with the exception of the variance.

The attraction of this model is its approach to the valuation of contingent claims. Since equity can be viewed as a contingent claim to the assets of a levered firm, this model provides a basis for equity valuation.

However, its relevance to information content research rests on its ability to capture a reasonable estimate of the market's expectation of the variability of stock returns. Before this connection is developed more fully, a brief review of some of the literature that empirically investigates the validity of the model is presented.

Black and Scholes (1972) conducted an empirical test of their model. The thrust of their test was to see if excess returns could be generated by purchasing options which were undervalued by the market (relative to the model) and short selling overvalued options. This was, in effect, a joint test: a test of the model and simultaneously a test of market efficiency. Using a historical time series to estimate the variance, they found that the model tended to systematically overestimate the value of options on high variance stocks and underestimate the value of options on low variance stocks. However, in most cases, this bias-induced spread was small enough to be explained by the existence of transactions costs. Also, when the variance was computed using the time series of future stock returns over the remaining life of the option, this spread was greatly diminished. These results seem to indicate that the market has information that goes beyond historical price data and can use this information to form expectations of the future variance of stock returns.

Macbeth and Mervill (1980) tested the Black-Scholes Options Model in an attempt to isolate any systematic biases in the model. Focusing on six particular stocks, for which a total of 12,000 individual option prices were gathered, Macbeth and Mervill did find some evidence of systematic bias. Under the assumption that "at the money" options (striking price equal to the market price of the stock) are correctly priced by the model, they used the market price of the option and the other observable inputs to solve for the standard deviation implied by those inputs (ISD). They computed an average implied standard deviation for each stock for each day. They then sought to determine the relationship between the degree to which an option was "in the money" (striking price less than market price of the stock) or "out of the money" (striking price greater than market price of the stock) and the deviation of model call prices from actual call prices. Their finding was that, on average, the Black-Scholes Options Model call prices were less (greater) than market call prices for "in (out of) the money" options. Systematic biases were also documented in other literature.

Schmalensee and Trippi (1978) tested the relationship between the ISD and a historical time series approach to estimating the standard deviation. They stated that their purpose was to determine if changes were occurring over

time in the market's collective expectation of common stock volatility. Aware of the Black-Scholes results, which showed that estimates of variability based on a time series of stock returns over the remaining life of the option produced a stronger confirmation of the model than a time series of historical returns, Schmalensee and Trippi sought to determine the degree to which information in the historical time series of returns was used by the market in forming its current expectation, as measured by the ISD. Their analysis showed virtually no relationship between standard deviations computed from historical time series and the ISD. Taken in conjunction with the Black-Scholes results, this seems to indicate that information other than historical returns data is available and utilized by the market in forming its expectation of returns variability and the the market does so with a reasonable degree of efficiency.

This very notion was the central issue of a study conducted by Chiras and Manaster (1978). They hypothesized that the market was semi-strong form efficient; therefore, it was not limited to historical returns information in estimating the standard deviation but included other sources of information. The question became: Is the ISD a more accurate estimator of the actual future standard deviation (SDFUT) than is the standard deviation calculated from a historical time series

(SDHIST)? Chiras and Manaster hypothesized this to be the case because "estimated variances calculated from the option prices should reflect not only information content of the stock price history but also any other available information".

They tested this hypothesis by regressing SDHIST and ISD (both separately and jointly) against SDFUT. It appeared that both measures, SDHIST and ISD, were good predictors of SDFUT and it is difficult to discriminate between them, although the ISD exhibited slight superiority. The regression coefficient for the SDHIST was significant at the 0.05 level twice out of 23 regressions, whereas the regression coefficient for the ISD was significant eight times at 0.05 and twice at 0.10. This appears to add support to the Schmalensee and Trippi study indicating that, to some degree, the ISD is formed with additional information beyond past stock price behavior. At a minimum, it supports the contention that the ISD is no worse a predictor of future variability than an estimate of variability using historical data alone.

This body of literature supports, overall, the development and use of the ISD measure as an approximation of the market's risk perception of a given stock. Although the absolute accuracy of this measure--the approximation compared to the true parameter--is not known, the above research does indicate that this measure

is at least as good as a historical time series in approximating the perceived riskiness of a given security. The relative advantage that the ISD has over the historical time series approach in predicting future risk, coupled with the fact that the options model allows risk to be measured with one observation at a point in time, establish the ISD as a sensitive measure of "instantaneous" risk and risk shifts associated with information content type studies.

Accounting Literature Using the Options Model

Patell and Wolfson (1979, 1981) have presented the only accounting studies to date which attempted to use the options model in an information content issue. They used the options model in determining if the market anticipated the additional security price variability around an earnings announcement as was documented by May (1971) and Beaver(1968). Since earnings announcements are made on a regular basis, if such variability is known to accompany the announcement, this expected future variability should be reflected in the implied standard deviation of a given option as long as the option expiration date is beyond the date of the earnings release. This should be the case since the implied standard deviation can be "generally defined as the average variance rate per unit time from the valuation date to the option expiration date" (p. 119,

1979). Patell and Wolfson (1979) hypothesized that the implied standard deviation for a given option would increase as a period of known stock price volatility approached, such as occurs at earnings announcements. Immediately following the information release, the implied standard deviation should return to its "normal" level. As with many other market-based investigations, a joint test is involved of both the options model and the market's ability to anticipate this forthcoming increased variability.

Patell and Wolfson (1979) used only non-calendar year firms to minimize the potential problem of interdependence across sample observations due to market-wide shifts in risk. Their data consisted of 28 firms that were traded on the Chicago Board Options Exchange and the American Options Exchange. This resulted in 83 observed annual earnings announcements over a five-year period. A six-week test period was used starting four weeks prior to the earnings announcement. The implied standard deviation was computed weekly except for the four days around the release during which it was calculated daily. The tests used consisted of visual inspection of the cross-sectional average implied standard deviations as well as non-parametric tests of consecutive changes.

The visual inspection is difficult to interpret, although the behavior of the lower quartile for both long

and short options strongly suggests that the hypothesized behavior is realized. Other quartiles are not so clear.

Ten different implied standard deviation shifts were calculated, five were strictly pre-announcement shifts, two were post-announcement shifts, two used the announcement day as one point from which the shift was computed and one measured the shift from the pre-announcement period to the post-announcement period. The first and last sets are of particular interest.

The Wilcoxon test noted positive shifts, the direction hypothesized, at a significance level equal to or less than 0.054, three out of five times for the pre-announcement shifts. Also, when the pre-announcement to post-announcement shift was considered, a negative shift was observed which the Wilcoxon test showed significant at less than 0.01. The Fisher test, which only proved significant one out of five times in the pre-announcement period, was significant at less than 0.01 for the pre to post-announcement shift. This offers reasonable evidence that the anticipated variability accompanying earnings releases is evidenced in the implied standard deviation.

Subsequent to the above study, Patell and Wolfson (1981) gained access to intraday option prices with corresponding stock price quotes. This basically eliminated a problem encountered when using financial

publications for option and stock price quotations, that of non-synchronous data. It also provided a sufficient data base for Patell and Wolfson to construct a market variability index which could control for market-wide risk shifts. This control is of particular importance where a number of observations occur at about the same time. With this control, Patell and Wolfson were able to expand their experimental set to include calendar-year firms. The number of annual earnings announcements observed was increased from the initial 83 to 292. This reflected the inclusion of calendar-year firms, but also a restriction to Chicago Board Options Exchange firms over a limited time.

Three different risk shift metrics were used. The first was a straight difference between the implied standard deviations prior to and subsequent to the earnings announcement. The second measure attempted to provide a cross-sectional standardization of risk shifts and the third incorporated the time until expiration in the risk shift calculation. The market index was used to control for market wide risk shifts and was applied only to the third risk shift above.

Using a Wilcoxon test and a Fisher test for changes in the implied standard deviation, the period from day -20 to day -2 showed significant positive shifts for short, medium, and long-term options for all uncontrolled

measures of risk shift. All significance levels were less than 0.10 and nine of the twelve measures were significant at 0.05 or less. The market-controlled shifts were not significant. The period over the release, day -2 to day +1, resulted in negative shifts with thirteen of the eighteen difference measures significant at 0.10 or less and six of these thirteen significant at 0.05 or less.

Patell and Wolfson then tested to determine if the magnitude of the pre-announcement risk shift was related to the magnitude of the price variability during the announcement. Using a rank order correlation procedure, they discovered consistent correlation coefficients with four of five risk shift metrics, but the level of significance was only between 0.10 and 0.20. They conclude that "weakly consistent" evidence is provided for such a relationship.

This research represents an initial use of the options model in information content type studies. The particular issue addressed by Patell and Wolfson was anticipated earnings announcements; and their results seem to confirm the conjecture that security price volatility due to an earnings announcement is reflected in the implied standard deviation of the options model. This adds another measure of credibility to the implied standard deviation metric. Patell and Wolfson did not test for shifts in the equilibrium level of the market

perceived riskiness due to the new information. Indeed, since any pre-announcement measure of the implied standard deviation would be composed of the expected normal variability plus the additional expected variability due to the earnings announcement, a clear measure of shifts in normal variability level would not have been possible. The issue addressed in this study, however, lends itself nicely to such a measure. As management earnings forecasts are not regularly scheduled or anticipated announcements, it is reasonable to assume that any measure of the implied standard deviation prior to the forecast release would not reflect any anticipated additional price volatility. Shifts in the normal variance level due to the new information in or accompanying an information release can be more clearly measured when management forecasts are studied (as explained later).

CHAPTER III
METHODOLOGY

Sample Selection and Design

The experimental design used in this study utilized an experimental group and two control groups. Both controls were selected using the same criteria. The purpose of using two alternate controls was to further ensure the validity of the control effect. The choice of admissible management forecasts was such that the forecast must have been both in the form of a point estimate or an interval estimate (converted to a single figure) and directly attributable to the company or some company official. The following information was collected with regard to each forecast:

a) The forecast date and amount, taken from the Wall Street Journal.

b) An average of published analysts' forecasts generated prior to the management forecast release. The Standard and Poor's Earnings Forecaster was used as the source for this information. No analyst forecast dated earlier than one month prior to the management forecast was used. (Approximately one half of the

forecast data specified above was obtained from Robert Beshara and used in·his study [1981]).

In addition to the forecast information, other data were collected as required by the options model and the market model (for use in the residuals tests).

Sixty-seven management forecasts from 60 firms were initially selected for this dissertation. These forecasts were published over the period 1974 through 1979. A major reason for the small sample size, relative to other similar studies, was the requirement that the firm be listed on one of the options exchanges at the time of the forecast. Upon review of the data, six observations were deleted from the analysis due to errors unnoticed in the first pass of data collection. The 61 remaining observations were examined for cases where the management forecast and the prior analyst's forecast were equal. As no defensible rationale could be developed for classifying these forecasts as positive or negative earnings shifts, and as relatively few observations were of this type (eleven), this group was deleted from the analysis. The final experimental group consisted of 50 forecast observations.

For each of the 50 experimental firms, two independent variables were calculated: the risk shift measure (R) and the earnings expectations shift measure (E). Both of these are discussed in detail below.

Independent Variables

The level of information content in the forecast was measured in the following way:

$$E = \frac{MF - AF}{AF} \times 100.0 \qquad (3.1)$$

Where MF = the point estimate of management's forecasted EPS (if an interval estimate was given, a simple average was used).

AF = an estimate of the market's expectation of EPS prior to the forecast release as measured by analyst forecasts (discussed below).

E = a measure of the new information in the management forecast with regard to the expected EPS.

The basic form of this "new information" metric is common to accounting literature. The measure of market expectations as used in this study is not as common and was recently introduced by Beshara (1981). Market expectations have commonly been measured by utilizing some mechanical model--as simple as a sub-martingale using the previous years' EPS to the more complex Box-Jenkins autoregressive, moving-average time series models.

Beshara (1981) used the last available analyst forecast prior to the management forecast release in determining his estimate of market expectations. The purpose of this approach was to attempt to capture an estimate of market expectations that has fully incorporated all publicly available information up to the release of the management forecast. Also, it seemed reasonable to assume that the market's EPS expectation for the firm is based on more than historical earnings data alone. The use of analyst forecasts as preferred surrogates for market expectations was based in part on the argument developed by Hakansson (1977) that, without superior analytical abilities, analysts would not be able to sustain their profession. Also, Brown and Rozeff (1978) indicated that analysts performed no worse than mechanical models in predicting annual EPS numbers and in some instances outperformed these models. Fried and Givoly (1982) found that the prediction errors of analysts were more closely associated with security price movements than those generated using mechanical models. This provided additional support to the contention that analysts' forecasts are valid surrogates for market expectations.

The operationalization of the risk shift variable was somewhat more involved. The following additional information, required as input to the options model, had to be extracted from Barrons for each of the thirteen

weeks surrounding the forecast:

a) The closing price for each option on a given firm's stock.

b) The striking price for each option.

c) The time until the expiration for each option.

d) The past dividend record of the firm's stock (so that anticipated dividend returns can be approximated).

e) The closing price of the stock.

f) The 90 day treasury bill rate as of that date (to be used as a surrogate for the risk free rate).

g) The expiration month of the option.

The above procedure required a considerable amount of information search, transcription, keypunching and verification since a large volume of data had to be transferred from physical volumes of The Wall Street Journal Index, Standard and Poor's Earnings Forecaster, and Barrons to a computer readable medium. A series of controls were implemented to minimize the probability of an error in this transfer process. The procedures followed are presented in Appendix B.

For each of the thirteen weeks that data were collected, a single Average Implied Standard Deviation (AISD) was computed for each firm. This was done by solving for the ISD for each option quote gathered (approximately 8% yielded no solution). The equally weighted arithmetic average (AISD) was computed for each

week for each firm as:

$$AISD = \frac{\sum_{m=1}^{M} ISD}{M} \qquad (3.2)$$

Where ISD = the Implied Standard Deviation, the direct result of the options model solution process

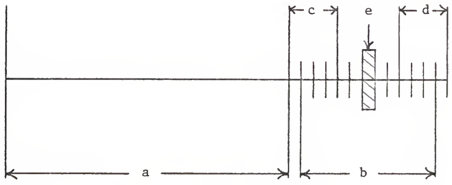
M = the number of options listed for a given firm in a given week

This resulted in 650 AISD measures (13 x 50) to be used in the empirical analysis.

The measures of pre-forecast and post-forecast variance were computed using two subperiods of four weeks each at the extremes of the thirteen week period over which options data were collected. The average AISD computed over the first four week period represented the market variance expectation before the forecast release (AISD-b) while the average AISD computed over the last four week period represented the market variance expectation after the forecast release (AISD-a). Table 3-1 presents the periods used for these variables, subperiods c and d, and shows their relationship to the total test period.

Table 3-1

Time Line for Model Estimation Periods And Test Period



a = The 150 week estimation period for the market model parameters.

b = The eleven week residual test period around the forecast week.

c = The four week period used to measure the average implied standard deviation prior to the forecast.

d = The four week period used to measure the average implied standard deviation subsequent to the forecast.

e = The forecast week.

The exclusion of the 5 week period around the forecast was based on two reasons. First, Patell and Wolfson (1979) documented unusually high volatility in the ISD measure immediately around an information release. Second, depending on the nature of the event(s) driving the management of a particular firm to release a forecast, information may have reached the market in advance of the forecast either through leakage or other channels. In an effort to minimize the potentially confounding impact that such early information might have on the risk-shift measure, the 5 week period surrounding the forecast was not used in computing that measure.

The risk shift was measured as the following ratio R:

$$R = \frac{AISD\text{-}a}{AISD\text{-}b} \tag{3.3}$$

where an increase in risk is indicated by $R > 1$ and a decrease in risk by $R < 1$. Summary statictics for both the risk shift measure and the mean earnings shift measure are presented in Table 3-2.

Dependent Variable

The dependent variable examined is the abnormal security return as measured against the expectation

Table 3-2

Summary Statistics for the Independent Variables

Decile	Earnings Shift (E)	Risk Shift (R)
0.10	-6.666	0.6455
0.20	-3.292	0.8057
0.30	-1.986	0.8672
0.40	-1.111	0.9385
0.50	0.013	1.0548
0.60	0.925	1.1202
0.70	2.272	1.3618
0.80	4.406	1.6502
0.90	10.169	2.0737
High	32.000	2.9644
Low	-23.076	0.3514
Mean	0.122	1.1758
Std. Dev.	8.866	0.5290

generated by the market model. The market model was estimated for each firm in order to generate returns expectations conditional on no information release over the test period. The 150 week period prior to the test period was used as the parameter estimation period. The test period was the eleven weeks surrounding the date of the forecast release. (See Table 3-1)

Standardized residuals for the portfolio level analysis (see Patell, 1976), were calculated from the market model:

$$R_{it} = a_i + b_i R_{mt} + e_{it} \tag{3.4}$$

where

$i = 1 \ldots I$, a forecast index

$t = 1 \ldots T$, a week index where $T=150$

R_{it} = the return on asset i in period t

R_{mt} = the market return in period t

a_i, b_i = the intercept and slope of the linear relationship between R_{it} and R_{mt}

e_{it} = the error term for asset i in period t where

$E(e_{it}) = 0$

$(R_{mt}, e_{it}) = 0$

$(e_{ij}, e_{it}) = 0$

Ordinary least squares regression was performed on realizations of R_{it} and R_{mt} to generate estimates for the regression coefficients a and b. These estimates were

then used over the test period (k=1, ... 11), along with the realizations of R_{mk}, to generate return expectations over the test period conditional on no information release.

$$r_{ik} = a_i + b_i R_{mk} \quad k = 1 \ . \ . \ . \ 11 \qquad (3.5)$$

The prediction error or abnormal return was calculated as the difference between the realization of R_{ik} and the conditional expectation of R_{ik}.

$$u_{ik} = R_{ik} - E(R_{ik}) \qquad (3.6)$$

This prediction error is assumed to be normally distributed with an expected value of zero and

$$\begin{aligned} \mathrm{Cov}(u_{is}, u_{ik}) &= 0 \ , \ s \neq k \\ &= C_{ik} \, Y_i \ , \ s = k \end{aligned}$$

where Y_i is the variance of the regression residuals over the estimation period and C_{ik} is an adjustment factor (explained below). The unbiased estimator for Y_i is S_i where:

$$S_i^2 = \frac{\sum_{t=1}^{T} u_{it}^2}{T-2} \tag{3.7}$$

Each individual prediction error over the test period can be standardized as:

$$VI_{ik} = \frac{u_{ik}}{S_i \sqrt{C_{ik}}} \quad \sim t(T-2) \tag{3.8}$$

where C_{ik} is the increase in variance due to prediction outside the estimation period, and is given by:

$$C_{ik} = 1 + \frac{1}{T} + \frac{(R_{mk} - \bar{R}_m)^2}{\sum_{t=1}^{T} (R_{mt} - \bar{R}_m)^2} \tag{3.9}$$

The cumulative standardized prediction error up to week L in the test period is

$$WI_{iL} = \sum_{k=1}^{L} \frac{u_{ik}}{S_i \sqrt{LC_{ik}}} \sim t(T-2) \qquad (3.10)$$

where L is equal to or less than eleven. Each statistic has an expected value equal to zero and a variance equal to (T-2)/(T-4), where T is the number of observations in the parameter estimation period. The prediction errors are assumed to be independent, identically distributed random variables.

The choice of weekly data was made for two reasons. First, weekly data would be better able to pinpoint information effects than would monthly data as weekly data provides a finer information set. Second, daily data, which was available, was deemed undesirable on the basis of prior studies, one of which concluded that "at present, there is only a little evidence supporting the adequacy of the market model for daily data. Indeed, the r^2's of model (1) for daily data are, in general, lower than those for weekly or monthly data. . ." (Lev, 1979, p.496).

Regression Analysis of Residuals

Many previous studies, such as those cited in Chapter II, utilized a partitioning of the experimental data set along a dimension established by the independent variable(s) and subsequent portfolio formation of all

firms assigned to a specific partition. This procedure was established to reduce measurement error by minimizing the effect of individual random return fluctuations. However, as in any grouping or averaging process, potential information may be lost. Most grouping procedures involve cell assignments based only on the sign of the independent variable(s), with no consideration of the magnitude. On the other hand, the use of regression analysis allows an investigation of both the sign and magnitude effects by maintaining all the information in the independent and dependent variables; that is, treating the dependent variable (abnormal security returns) and the independent variables as continuous (ratio) scale measures.

The specific form of the ordinary least squares general linear model used was as follows:

$$WI_{iL} = b_0 + b_E E_i + b_R R_i \tag{3.11}$$

where

WI_{iL} = the cumulative standardized prediction error for forecast i through test week L as defined in (3.10)

E_i = the independent variable measuring the shift in the earnings expectation for forecast i as defined in (3.1)

R_i = the independent variable measuring the risk shift for forecast i as defined in (3.3)

b_O, b_E, b_R = the regression parameters

In regression analysis, the two most commonly used hypothesis testing precodures are the overall test for goodness of fit of the model and a test for specific (individual) regression coefficients. Both of these tests are employed in this dissertation.

Consistent with the design in Tables 1-1 and 3-3, specific directions can be hypothesized for two of the regression parameters (no sign is hypothesized for the intercept parameter). The earnings expectation shift is hypothesized to be directly (positively) related to the abnormal returns while the risk shift is inversely (negatively) related. As such, one-tailed tests are appropriate.

Partitioned Analysis of Residuals

This approach represents the more conventional type of analysis conducted in a typical market-based information content study. This type of analysis is included here for the following reasons. First, as numerous other studies have utilized this approach, it provides a means of comparison with earlier studies, particularly with regard to the earnings shift variable which has been investigated previously. This comparison

Table 3-3

The Anticipated Impact on Stock Returns
Given the Type of EPS Forecast
(Based on Four Partitions)

		Changes in EPS Variance	
		Decrease (R<1)	Increase (R>1)
Changes in EPS Mean	Increase (E>0)	1 Positive	2 Uncertain
	Decrease (E<0)	3 Uncertain	4 Negative

would provide a means of validating the data used in this study.

A second motivation for including the traditional partitioned analysis is to allow a comparison between the two methods of analysis, regression versus partitioning. This comparison is important because of the particular tradeoffs between the two methods: the regression approach incorporates both the sign and the magnitude of the independent variables (thus possibily adding an element of noise) while the partitioning approach attempts to minimize the noise but loses the magnitude information in the process.

The partitioning was accomplished using the computed earnings shift and risk shift variables. Each experimental firm was assigned to one of four classifications: positive earnings shift with negative risk shift (Cell 1), positive earnings shift with positive risk shift (Cell 2), negative earnings shift with negative risk shift (Cell 3), and negative earnings shift with positive risk shift (Cell 4). This design is presented in Table 3-3 and is consistent with the overall approach presented in Chapter I (see Table 1-1). It does, however, reflect the sample size constraint in that four classifications, instead of the earlier nine, are used. The cell characteristics and sample sizes can be summarized as:

	Characteristics	Sample Sizes
Cell 1	$E>0,\ R<1$	12
Cell 2	$E>0,\ R>1$	13
Cell 3	$E<0,\ R<1$	12
Cell 4	$E<0,\ R>1$	13

By application of the Central Limit Theorem, the intracell cross-sectional mean of the standardized prediction error and cumulative standardized prediction error for any week in the test period approaches a standard normal distribution as T becomes large. This normalized statistic is expressed as:

$$VP_k = \frac{\sum_{i=1}^{N} VI_{ik}}{\sum_{i=1}^{N} \left[\frac{T_i - 2}{T_i - 4} \right]^{1/2}} \qquad (3.14)$$

The cumulative cross-sectional standardized prediction error can be expressed as:

$$WP_k = \frac{\sum_{k=1}^{L} VP_k}{\sqrt{L}} \qquad (3.15)$$

Equations (3.14) and (3.15) are the basis for the test of

the hypothesis that the standardized cross-sectional prediction error is significantly different from zero.

Between cell comparisons are also made using a Student's t test of differences in sample means. Of particular interest are the comparison of the extreme cells, Cell 1 versus Cell 4. This analysis uses the individual firm cumulative standardized prediction error as the variable of interest, with cell classification determining the group assignment.

Control Portfolios

The foregoing analysis has been presented as being conducted on the abnormal returns of the firms or portfolios from the experimental set only. To control for possible model misspecifications or systematic effects due to the particular options exchange that a firm is traded on, two sets of control firms were chosen. Each control firm was randomly selected from the same options exchange as its corresponding experimental firm. Two controls were used solely to validate the control procedure itself.

The market model and the related prediction error and standardization techniques were applied to each of the control firms to calculate the string of individual and cumulative standardized residuals over the test period. The regression analysis described earlier used individual experimental firm standardized residual statistics. The

prediction errors for the control firms can be incorporated into the analysis resulting in a difference statistic computed as:

$$DWI_{iL} = \frac{WI_{iL} - CWI_{iL}}{SF} \tag{3.16}$$

where:

$$SF = \left[\frac{2\ (T - 2)}{(T - 4)}\right]^{1/2} \tag{3.17}$$

CWI_{iL} = the cumulative standardized residual for control firm i in week L.

This difference statistic was used as the dependent variable. Regression analysis was then employed on the difference (controlled) statistics in a manner identical to that specified for the noncontrolled group. The calculations were made twice, once for each control group. Summary statistics for the dependent variable, in both its original form and controlled form, are presented in Table 3-4.

In the partitioned analysis, the matching of specific control firms to experimental firms allowed control portfolios to be formed for each partition. Portfolio

Table 3-4

Summary Statistics for the Dependent Variable

Decile	Experimental Sample Only WI_{11}	Adjusted with Control Group One DWI^{1}_{11}	Adjusted with Control Group Two DWI^{2}_{11}
0.10	-1.035	-1.420	-1.098
0.20	-0.886	-0.795	-0.792
0.30	-0.605	-0.593	-0.572
0.40	-0.337	-0.448	-0.297
0.50	-0.165	-0.084	-0.068
0.60	0.100	0.086	0.163
0.70	0.254	0.343	0.600
0.80	0.677	1.034	0.928
0.90	1.187	2.093	1.651
High	2.387	2.749	1.957
Low	-1.991	-2.055	-3.370
Mean	-0.102	0.041	-0.027
Std. Dev.	0.893	1.223	1.063

difference statistics, experimental minus control, were calculated as:

$$DWP_L = \frac{WP_L - CWP_L}{SF} \tag{3.18}$$

where SF is defined in equation 3.17. The testing procedure for the controlled analysis was the same as that used in the noncontrolled analysis.

Hypotheses

This study investigates two basic hypotheses.

Ho_1 : Shifts in expected earnings occasioned by a management forecast will not impact a firm's security price behavior.

Ha_1 : Positive (negative) shifts in expected earnings will have a positive (negative) impact on a firm's security price behavior.

Ho_2 : Shifts in the perceived riskiness of a firm corresponding to a management forecast release will not impact the firm's security price behavior.

Ha_2 : Increases (decreases) in the perceived riskiness of a firm corresponding to the release of a management forecast will have a negative

(positive) impact on a firm's security price behavior.

The above hypotheses are tested jointly, examining earnings and risk effects simultaneously, and individually. They are tested using both the regression and the partitioned approaches outlined earlier. The specific operational hypotheses are detailed below.

Operational Hypotheses For Regression Analysis

The hypotheses presented below regarding the regression analysis are also presented in detail in Table 3-5.

$RHo_{1,2}$: The overall two-factor model of earnings shift and risk shift does not explain any variation in abnormal returns ($b_E = b_R = 0$).

$RHa_{1,2}$: The overall two-factor model of earnings shift and risk shift explains some variation in abnormal returns ($b_E \neq 0$ and/or $b_R \neq 0$).

RHo_1 : The earnings expectations shift regression coefficient equals zero ($b_E = 0$).

RHa_1 : The earnings expectations shift regression coefficient is greater than zero ($b_E > 0$).

RHo_2 : The risk shift regression coefficient equals zero ($b_R = 0$).

RHa_2 : The risk shift regression coefficient is less than zero ($b_R < 0$).

Table 3-5

Operational Hypothesis for Regression Analysis

MODELS : $WI_{i,11} = b_0 + b_E E_i + b_R R_i$

$DWI_{i,11} = b_0 + b_E E_i + b_R R_i$

$WI_{i,11}$ = the cumulative standardized prediction error (4.10) for forecast i through week eleven of the test period.

$DWI_{i,11}$ = the cumulative residual statistic difference for week eleven between the firm with forecast i and its control firm (in control group one or two).

E_i = the independent variable measuring the shift in earnings expectations for forecast i (4.1).

R_i = the independent variable measuring the risk shift for forecast i (4.3).

b_0, b_E, b_R = The regression parameters.

Hypothesis Regarding the Overall Significance of the Above Models

H_o : F value is not significant.

H_a : F value of regression is significant with $b_E > 0$, and $b_R < 0$.

Hypotheses for Individual Tests of Earnings Shift Effect and Risk Shift Effect

Test of Mean Earnings Shift Effect	Test of Risk Shift Effect
$H_o : b_E = 0$	$H_o : b_R = 0$
$H_a : b_E > 0$	$H_a : b_R < 0$

Operational Hypotheses For Partitioned Analysis

The hypotheses presented below regarding the partitioned analysis are also presented in detail in Table 3-6.

$PHo_{1,2}$: When partitioned by risk shift and expected earnings shift, there will be no difference between the portfolio cumulative residuals of the four partitions.

$PHa_{1,2}$: When partitioned by risk shift and expected earnings shift, Cell 1 (positive earnings shift, negative risk shift) will outperform all other portfolios, and Cell 4 (negative earnings shift, positive risk shift) will be outperformed by all other portfolios.

PHo_1 : When partitioned by the expected earnings shift, there will be no difference between the portfolio cumulative residuals of the positive and negative earnings shift partitions.

PHa_1 : When partitioned by the expected earnings shift, the partition including Cells 1 and 2 (positive earnings shift) will outperform the partition including Cells 3 and 4 (negative earnings shift).

PHo_2 : When partitioned by the risk shift, there will be no difference between the portfolio

Table 3-6

Operational Hypothesis for Partitioned Analysis

Experimental Cell		Hypothesis Related to	
Cell #	E R	Experimental Sample Only	Difference Between Experimental and Control Samples
1	E+ R-	$H_o : WP_{11} = 0$ $H_a : WP_{11} > 0$	$H_o : DWP_{11} = 0$ $H_a : DWP_{11} > 0$
2 3	E+ R+ E- R-	$H_o : WP_{11} = 0$ $H_a : WP_{11} \neq 0$	$H_o : DWP_{11} = 0$ $H_a : DWP_{11} \neq 0$
4	E- R+	$H_o : WP_{11} = 0$ $H_a : WP_{11} < 0$	$H_o : DWP_{11} = 0$ $H_a : DWP_{11} < 0$
1 & 2	E+	$H_o : WP_{11} = 0$ $H_a : WP_{11} > 0$	$H_o : DWP_{11} = 0$ $H_a : DWP_{11} > 0$
3 & 4	E-	$H_o : WP_{11} = 0$ $H_a : WP_{11} < 0$	$H_o : DWP_{11} = 0$ $H_a : DWP_{11} < 0$
1 & 3	R-	$H_o : WP_{11} = 0$ $H_a : WP_{11} > 0$	$H_o : DWP_{11} = 0$ $H_a : DWP_{11} > 0$
2 & 4	R+	$H_o : WP_{11} = 0$ $H_a : WP_{11} < 0$	$H_o : DWP_{11} = 0$ $H_a : DWP_{11} < 0$

WP_{11} = the 11 week cumulative standardized prediction error per cell for the experimental sample.

DWP_{11} = the difference in cumulative standardized prediction error between the experimental group and the control group for each cell.

cumulative residuals of the negative and positive risk shift partitions.

PHa_2 : When partitioned by the risk shift, the partition including Cells 1 and 3 (negative risk shift) will outperform the partition including Cells 2 and 4 (positive risk shift).

The above operational hypotheses (both regression-RH and partitioned-PH) are first tested on the abnormal security returns obtained from experimental firms' observations only. Then, to control for possible model misspecification, the abnormal returns of the experimental set are adjusted by subtracting the abnormal returns of the control set as in (3.16).

CHAPTER IV
RESULTS

Introduction

The focus of this study is the investigation of the relationship between security price behavior and the shifts in earnings expectations and perceived risk signalled by a given management forecast. Two approaches were specified for testing the hypotheses. The first approach was the regression analysis and the second was the partitioned analysis. Chapter III also presented a section on the incorporation of control firms in the analysis. To avoid repetition in discussing the results and implications of this study, the controlled results are discussed along with the non-controlled.

Within each approach, results with regard to the joint hypothesis are discussed first followed by discussion of the individual parameter hypotheses. The earnings shift effect is discussed first and then the risk shift effect. Examining the earnings shift effect ahead of the risk shift effect will allow a validation of the data set with respect to prior forecasting research.

Regression Analysis

This analysis treats each variable as a continuous variable and seeks to determine the relationship between the dependent variable, the standardized cumulative excess returns (WI) over the test period, and the two independent variables, expected earnings shift (E) and risk shift (R). With regard to the two independent variables, it should be noted that the inter-variable correlation coefficient is only 0.04 (significance level of 0.74) thus minimizing any concerns about multicollinearity in the regression. The operational individual hypotheses, RH, are examined in this section. The joint hypothesis related to the individual firm behavior, $RHo_{1,2}$, is examined first.

The joint hypothesis states that neither variable will impact the security pricing mechanism. Table 4-1 presents the results of the regression using the non-controlled residual statistics. The analysis included 50 observations and estimated three parameters, thus resulting in 47 degrees of freedom for use with the error. The resulting F value of 4.83 has an alpha level of 0.0124, indicating a statistically significant relationship between the independent variables and the dependent variable. Also, in rejecting the null hypothesis, the regression coefficient for each of the

Table 4-1

Results of Ordinary Least Squares Model

Regression Model of
Non-Controlled Individual Firm Cumulative Residuals
on Mean Earnings Shift (E) and Risk Shift (R)

MODEL: $WI_{i,11} = b_0 + b_E E_i + b_R R_i$

$WI_{i,11}$ = the cumulative standardized prediction error for forecast i through week eleven of the test period as defined in (4.10).

E_i = the independent variable measuring the shift in earnings expectations for forecast i as defined in (4.1).

R_i = the independent variable measuring the risk shift for forecast i as defined in (4.3).

b_0, b_E, b_R = the regression parameters.

F value	F significance level	r^2
4.83	0.0124	0.1704

Parameter	Estimate	t value	t significance level
b_E	0.01092	2.74	0.0043
b_R	-0.09802	-1.47	0.0747

independent variables behaves in the predicted direction. This result is confirmed in the subsequent controlled analyses, Tables 4-2 and 4-3, which yield model significance levels of 0.0477 and 0.0034 respectively.

The r^2 statistic presents the degree to which variability in the dependent variable is explained by movements in the independent variables. The analysis conducted in this study resulted in r^2 values of 0.1704, 0.2152, and 0.1215 for the non-controlled residuals, and those adjusted for control group one and control group two respectively. Therefore, it appears that a reasonable level of explanatory power resides within the independent variables.

Although the overall model exhibits a strong level of significance, individual model components must be examined for their contribution. This is the essence of hypotheses RHo_1 and RHo_2. With regard to the expected earnings shift parameter, E, Table 4-1 reports a positive regression coefficient with a 0.0043 probability of a type I (alpha) error. This is strong evidence in support of rejecting the null hypothesis in favor of the one-tailed alternative, RHa_1. This result is confirmed in the analysis adjusted for control group 1 as presented in Table 4-2. This analysis resulted in a positive regression coefficient at a significance level of 0.0017. The analysis adjusted by control group 2, Table 4-3,

Table 4-2

Results of Ordinary Least Squares Model

Regression Model of
Individual Firm Cumulative Residual Differences (Control 1)
on Mean Earnings Shift (E) and Risk Shift (R)

$$\text{MODEL:} \quad DWI^{1}_{i,11} = b_0 + b_E E_i + b_R R_i$$

$DWI^{1}_{i,11}$ = Cumulative residual statistic differences for week eleven between experimental firm i and its appropriate control firm in control group one.

E_i = the independent variable measuring the shift in earnings expectations for forecast i as defined in (4.1).

R_i = the independent variable measuring the risk shift for forecast i as defined in (4.3).

b_0, b_E, b_R = the regression parameters.

F value	F significance level	r^2
6.44	0.0034	0.2152

Parameter	Estimate	t value	t significance level
b_E	0.01652	3.07	0.0017
b_R	-0.16656	-1.85	0.0354

Table 4-3

Results of Ordinary Least Squares Model

Regression Model of
Individual Firm Cumulative Residual Differences (Control 2)
on Mean Earnings Shift (E) and Risk Shift (R)

$$\text{MODEL:} \quad DWI^2_{i,11} = b_0 + b_E E_i + b_R R_i$$

$DWI^2_{i,11}$ = Cumulative residual statistic differences for week eleven between experimental firm i and its appropriate control firm in control group two.

E_i = the independent variable measuring the shift in earnings expectations for forecast i as defined in (4.1).

R_i = the independent variable measuring the risk shift for forecast i as defined in (4.3).

b_0, b_E, b_R = the regression parameters.

F value	F significance level	r^2
3.25	0.0477	0.1214

Parameter	Estimate	t value	t significance level
b_E	0.00547	1.11	0.1369
b_R	-0.18980	-2.29	0.0131

yielded weaker results. Although the regression coefficient is still positive, the probability of significance is only 0.1369, considerably weaker than the first two. Overall, though, strong support is presented for the rejection of the null hypothesis RHo_1.

The risk shift parameter, R, is the second parameter inspected. The non-controlled analysis yielded a negative regression coefficient, consistent with the alternative hypothesis, and a significance level for that coefficient of 0.0747. Although not extremely strong, this statistic favors rejecting the null hypothesis. Inspection of the resulting significance levels in the analysis adjusted for control groups 1 and 2 adds support for this conclusion. Both analyses yielded negative regression coefficients and significance levels of 0.0354 and 0.0131 respectively. The support for the rejection of the null hypothesis, RHo_2, is not as strong as that for rejection of RHo_1; however, as a whole, this analysis provides considerable support for rejecting the null hypothesis in favor of the alternative, RHa_2.

Partitioned Analysis

This analysis partitioned each dimension, earnings shift and risk shift, on two levels (increasing +, decreasing -), resulting in a two by two design. The

experimental group was accordingly divided into four portfolios (Cell 1, Cell 2, Cell 3, and Cell 4). Table 4-4 presents summary statistics for the independent variables for each of the four experimental cells.

Table 4-5 reports the portfolio standardized prediction errors, VP_k's, and the cumulative portfolio standardized prediction errors, WP_k's, for each of the four portfolios over the eleven week test period for the experimental firms. The Cell 1 portfolio exhibits the most positive abnormal price behavior while the Cell 4 portfolio exhibits the most negative price behavior. As these are the only two portfolios about which specific behavior could be anticipated (Cell 2 and Cell 3 portfolios are mixed news portfolios) the difference in final WP's of 2.79 (the related Z statistic is 1.97) indicates a strong joint partitioning effect in the independent variables. The results of the mixed news portfolios fall between those for the Cell 1 and Cell 4 portfolios, thus supporting a mixed news inference. This is further supported by inspection of Table 4-6, which maps the probability of observing, in any week, the sample difference attained given that no difference exists between population parameters. The significance level reaches 0.09 in week 3, 0.15 in week 4, 0.05 in week 5 and remains below that level through the full test period. A one-tailed test is appropriate since the direction of the

Table 4-4

Summary Table of Experimental Portfolio Descriptive Statistics and Anticipated Returns Behavior

Cell 1			Cell 2		
R:	Mean	0.818	R:	Mean	1.506
	S.D.	0.173		S.D.	0.401
	PR>¦t¦	0.001		PR>¦t¦	0.001
E:	Mean	6.645	E:	Mean	4.724
	S.D.	9.531		S.D.	4.798
	PR>¦t¦	0.034		PR>¦t¦	0.004
Anticipated Abnormal Returns - Positive			Anticipated Abnormal Returns - Uncertain		
Cell 3			**Cell 4**		
R:	Mean	0.747	R:	Mean	1.570
	S.D.	0.128		S.D.	0.584
	PR>¦t¦	0.001		PR>¦t¦	0.001
E:	Mean	-5.050	E:	Mean	-5.722
	S.D.	5.861		S.D.	7.340
	PR>¦t¦	0.012		PR>¦t¦	0.016
Anticipated Abnormal Returns - Uncertain			Anticipated Abnormal Returns - Negative		

Table 4-5

Residual Statistics (VP_k) and Cumulative Residual Statistics (WP_L) of the Experimental Portfolios Partitioned on Mean Earnings Shift and Risk Shift

Partition Assignment

WEEK	Cell 1		Cell 2		Cell 3		Cell 4	
	VP_k	WP_L	VP_k	WP_L	VP_k	WP_L	VP_k	WP_L
1	0.51	0.51	-0.99	-0.99	-0.67	-0.67	-2.04*	-2.04*
2	-0.08	0.31	0.04	-0.68	-0.54	-0.85	1.50	-0.38
3	0.26	0.40	0.52	-0.25	1.17	-0.02	-1.33	-1.08
4	0.54	0.62	-0.51	-0.47	-0.24	-0.14	0.61	-0.63
5	0.01	0.56	1.84*	0.40	-0.76	-0.46	-1.18	-1.09
6	0.48	0.70	-0.28	0.27	-1.00	-0.83	-0.72	-1.29
7	0.89	0.99	0.79	0.54	-0.47	-0.95	-0.65	-1.44
8	-0.32	0.81	-1.03	0.14	-0.65	-1.12	-0.61	-1.56
9	0.27	0.85	0.80	0.40	0.50	-0.89	0.47	-1.32
10	1.00	1.12	-0.99	0.07	-0.65	-1.05	-0.16	-1.30
11	-0.04	1.06	0.56	0.23	-0.06	-1.02	-1.64*	-1.73*

* Significant at the 0.05 level

Table 4-6

Student's t Statistics and Significance Levels for Differences in Group Means of the Cumulative Standardized Residuals Between Cell One and Cell Four (Cell One Minus Cell Four)

Experimental Firms Only

Week	Calculated Student's t	One-Tailed Significance Level
1	2.12	0.02
2	-0.62	0.27
3	1.38	0.09
4	1.04	0.15
5	1.65	0.05
6	2.12	0.02
7	2.15	0.02
8	2.13	0.02
9	1.91	0.03
10	1.89	0.03
11	2.13	0.02

difference has been predicted. These results support the rejection of the null hypothesis, $PHo_{1,2}$ in favor of the alternative hypothesis, $PHa_{1,2}$, which proposed a difference between cells and specified the direction of that difference. Graphical representation of these results over the test period, presented in Figure 4-1, also supports the rejection of the null hypothesis.

Residual statistics for the two control groups were calculated as specified in Chapter III. The VP's and WP's of the experimental firms were adjusted to reflect the control effect. These controlled residual statistics, DVP and DWP, are presented in Tables 4-7 and 4-8 for the experimental less control group 1 and experimental less control group 2 respectively. In both cases, the inclusion of the control group does not alter the ranking of the final cumulative portfolio statistic: Cell 1 is the largest positive final DWP statistic with Cell 4 yielding the largest negative. Using control group 1, the difference is 3.92; with control group 2 the difference is 2.07. (The corresponding Z statistics are 2.77 and 1.46.) Also, the mixed news portfolios again yield results that fall between the Cell 1 and Cell 4 portfolios. This adds support to the directionally stated alternative hypothesis. This is further supported by inspection of Tables 4-9 and 4-10. Again, these map the probability of observing a sample difference if no population difference

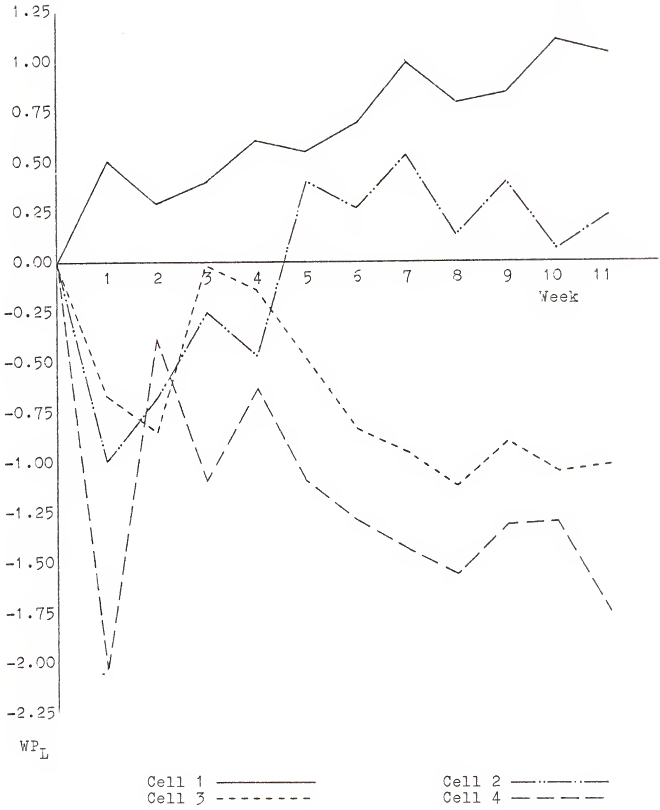


Figure 4-1
Cumulative Residual Statistics (WP_L) of the Experimental Portfolios Partitioned on Mean Earnings Shift and Risk Shift

Table 4-7

Residual Statistics Differences (DVP_k) and Cumulative Residual Statistics Differences (DWP_L) between Experimental Portfolios and Control Group One

Partition Assignment

WEEK	Cell 1		Cell 2		Cell 3		Cell 4	
	DVP_k	DWP_L	DVP_k	DWP_L	DVP_k	DWP_L	DVP_k	DWP_L
1	0.42	0.42	-0.63	-0.63	-0.54	-0.54	-1.39	-1.39
2	0.01	0.31	0.07	-0.39	-0.43	-0.69	1.08	-0.22
3	0.22	0.38	0.42	-0.07	0.75	-0.13	-0.86	-0.69
4	0.43	0.55	-0.40	-0.26	-0.23	-0.23	0.46	-0.37
5	-0.23	0.39	0.98	0.20	-0.55	-0.45	-0.53	-0.56
6	-0.07	0.32	-0.38	0.02	-0.23	-0.51	-0.08	-0.55
7	1.60	0.90	1.25	0.49	-1.15	-0.90	-0.56	-0.72
8	0.77	1.12	-0.84	0.16	-0.19	-0.91	-0.52	-0.86
9	-0.33	0.94	0.59	0.35	0.00	-0.86	-0.52	-0.99
10	2.46 @	1.67*	0.02	0.34	-0.32	-0.92	1.00	-0.62
11	0.78	1.83*	1.15	0.67	-0.36	-0.98	-1.66*	-1.09

* Significant at the 0.05 level

@ Significant at the 0.01 level

Table 4-8

Residual Statistics Differences (DVP_k) and Cumulative Residual Statistics Differences (DWP_L) between Experimental Portfolios and Control Group Two

Partition Assignment

WEEK	Cell 1		Cell 2		Cell 3		Cell 4	
	DVP_k	DWP_L	DVP_k	DWP_L	DVP_k	DWP_L	DVP_k	DWP_L
1	0.29	0.29	-0.65	-0.65	-0.37	-0.37	-1.38	-1.38
2	-0.13	0.11	0.08	-0.40	-0.23	-0.43	1.09	-0.20
3	0.11	0.15	0.46	-0.06	0.94	0.18	-0.90	-0.68
4	0.32	0.30	-0.26	-0.18	-0.06	0.12	0.48	-0.35
5	-0.20	0.17	1.64*	0.56	-0.10	0.09	-1.94*	-1.18
6	1.24	0.67	1.11	0.97	-0.67	-0.21	-1.33	-1.63
7	1.09	1.03	0.89	1.23	0.35	-0.06	-0.88	-1.84*
8	-0.57	0.76	-0.26	1.06	-0.36	-0.18	0.13	-1.68*
9	-0.22	0.64	-0.52	0.82	1.02	0.16	0.56	-1.39
10	0.10	0.64	-0.93	0.49	-0.67	-0.05	0.28	-1.23
11	0.02	0.62	0.39	0.58	0.19	0.00	-0.91	-1.45

* Significant at the 0.05 level

Table 4-9

Student's t Statistics and Significance Levels for Differences in Group Means of the Cumulative Standardized Residuals Between Cell One and Cell Four (Cell One Minus Cell Four)

Controlled by Control Group One

Week	Calculated Student's t	One-Tailed Significance Level
1	2.15	0.02
2	0.70	0.24
3	1.45	0.08
4	1.09	0.14
5	1.17	0.13
6	0.99	0.16
7	1.66	0.05
8	2.07	0.03
9	2.04	0.03
10	2.25	0.02
11	2.76	0.01

Table 4-10

Student's t Statistics and Significance Levels for Differences in Group Means of the Cumulative Standardized Residuals Between Cell One and Cell Four (Cell One Minus Cell Four)

Controlled by Control Group Two

Week	Calculated Student's t	One-Tailed Significance Level
1	2.11	0.02
2	0.43	0.33
3	1.21	0.12
4	0.88	0.19
5	2.03	0.03
6	2.90	0.01
7	2.62	0.01
8	2.29	0.02
9	1.75	0.05
10	1.62	0.06
11	1.74	0.05

exists. Graphical representations of the cumulative residuals are presented in Figures 4-2 and 4-3.

Table 4-10, using control group 2, shows almost identical results to Table 4-6, the experimental set only, in that a significance level of less that 0.05 is attained by week 5 and that level is maintained over all but one of the remaining weeks (the difference in week 10 shows significance at 0.06). The analysis with control group 1, Table 4-9, does show some departure from the pattern in Tables 4-6 and 4-10. The significance level of the difference does not drop to 0.05 until week 7, one week after the announcement. As such, the inclusion of the control groups does not appear to aid in detecting these effects; in fact, the random nature of the controls along with the small sample sizes may have served only to introduce additional noise into the analysis, thus bringing about the observed departure noted in Table 4-9. The important factor is that the use of controls does not significantly alter the overall non-controlled results.

An item of interest at this point is the specific behavior of the individual mixed news portfolios. With regard to the final WP statistic, the Cell 2 portfolio consistently outperformed the Cell 3 portfolio. This is particularly evident in Figure 4-1, and somewhat less clear in Figures 4-2 and 4-3. This may be indicative of a stronger mean shift effect relative to the risk shift

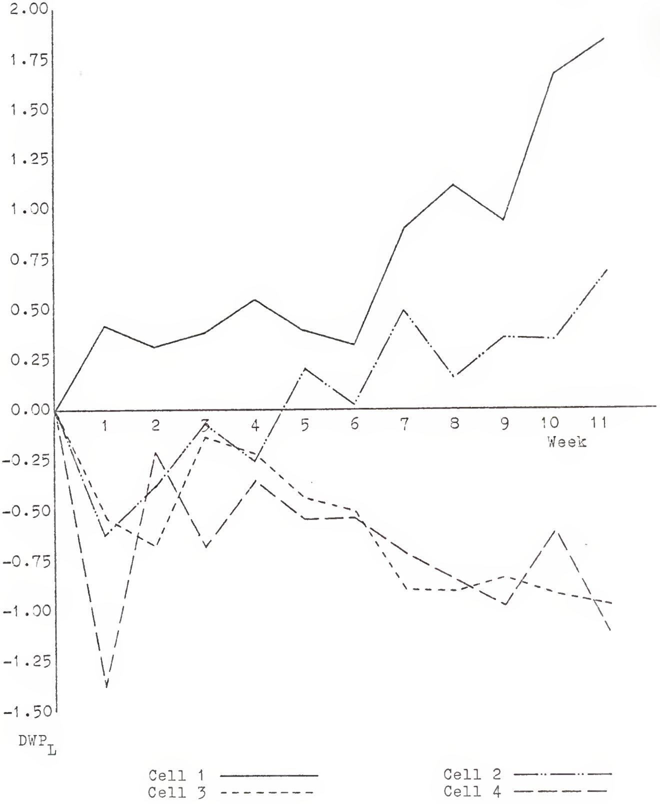


Figure 4-2
Cumulative Residual Statistics Differences (DWP_L) Between Experimental Portfolios and Control Group One

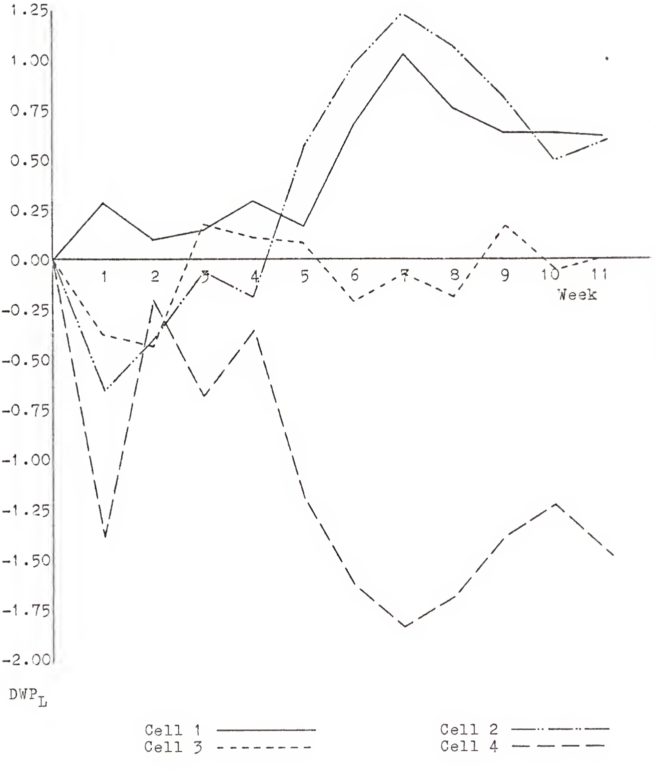


Figure 4-3
Cumulative Residual Statistics Differences (DWP_L)
Between Experimental Portfolios and Control Group Two

effect in a management forecast situation. Or, it may be a function of the operational measures used in capturing these dimensions. In either case, the difference between the Cell 2 and Cell 3 portfolios does not appear sufficiently strong to warrant a position on the issue.

As a means of assessing the degree to which each parameter individually contributed to the joint effect, each dimension was investigated in isolation. The earnings shift dimension is discussed first. This analysis serves as a data validation measure since the results for this dimension have been well documented. Table 4-11 reports the VP's and WP's over the test period for portfolios E+ and E-. DVP's and DWP's, adjusting for the control groups, are presented in Tables 4-12 and 4-13. Graphical representations are shown in Figures 4-4, 4-5, and 4-6. In all three cases, there is strong evidence in favor of rejecting the null hypothesis, PHo_1. The difference in the final WP statistic in the non-controlled analysis is 2.85 (the Z statistic is 2.00) while in the controlled analysis, the differences in the final DWP's are 3.22 (the Z statistic is 2.26) and 1.89 (the Z statistic is 1.33) when control group 1 and control group 2 are respectively included. The test of group means, in Table 4-14, adds further support to this effect as indicated by a significant difference in both week 7 and week 11. Although the week 11 difference is the focus of

Table 4-11

Residual Statistics (VP_k) and Cumulative Residual Statistics (WP_L) of the Experimental Portfolios Partitioned on Mean Earnings Shift

Partition Assignments

WEEK	Cells 1 & 2 (E+)		Cells 3 & 4 (E-)	
	VP_k	WP_L	VP_k	WP_L
1	-0.36	-0.36	-1.94*	-1.94*
2	-0.03	-0.28	0.71	-0.87
3	0.56	0.10	-0.15	-0.79
4	0.00	0.09	0.28	-0.55
5	1.34	0.68	-1.38	-1.11
6	0.15	0.68	-1.22	-1.51
7	1.18	1.08	-0.80	-1.70*
8	-0.97	0.67	-0.90	-1.90*
9	0.76	0.88	0.69	-1.57
10	-0.02	0.83	-0.56	-1.66*
11	0.37	0.90	-1.22	-1.95*

* Significant at the 0.05 level

Table 4-12

Residual Statistics Differences (DVP_k) and Cumulative Residual Statistics Differences (DWP_L) between Experimental Portfolios and Control Group One Partitioned on Mean Earnings Shift

Partition Assignments

WEEK	Cells 1 & 2 (E+)		Cells 3 & 4 (E-)	
	DVP_k	DWP_L	DVP_k	DWP_L
1	-0.16	-0.16	-1.38	-1.38
2	0.06	-0.06	0.47	-0.64
3	0.46	0.21	-0.11	-0.59
4	0.01	0.19	0.17	-0.42
5	0.54	0.41	-0.76	-0.72
6	-0.33	0.24	-0.22	-0.75
7	2.01*	0.98	-1.20	-1.15
8	-0.07	0.89	-0.50	-1.26
9	0.19	0.91	-0.37	-1.31
10	1.73*	1.41	0.50	-1.08
11	1.37	1.75*	-1.44	-1.47

* Significant at the 0.05 level

Table 4-13

Residual Statistics Differences (DVP_k) and Cumulative Residual Statistics Differences (DWP_L) between Experimental Portfolios and Control Group Two Partitioned on Mean Earnings Shift

Partition Assignments

WEEK	Cells 1 & 2 (E+)		Cells 3 & 4 (E-)	
	DVP_k	DWP_L	DVP_k	DWP_L
1	-0.27	-0.27	-1.25	-1.25
2	-0.03	-0.21	0.62	-0.44
3	0.41	0.06	0.00	-0.36
4	0.03	0.07	0.29	-0.16
5	1.04	0.53	-1.47	-0.81
6	1.66*	1.16	-1.42	-1.32
7	1.40	1.61	-0.39	-1.37
8	-0.58	1.30	-0.15	-1.34
9	-0.53	1.04	0.89	-1.11
10	-0.60	0.80	-0.25	-0.92
11	0.29	0.85	-0.52	-1.04

* Significant at the 0.05 level

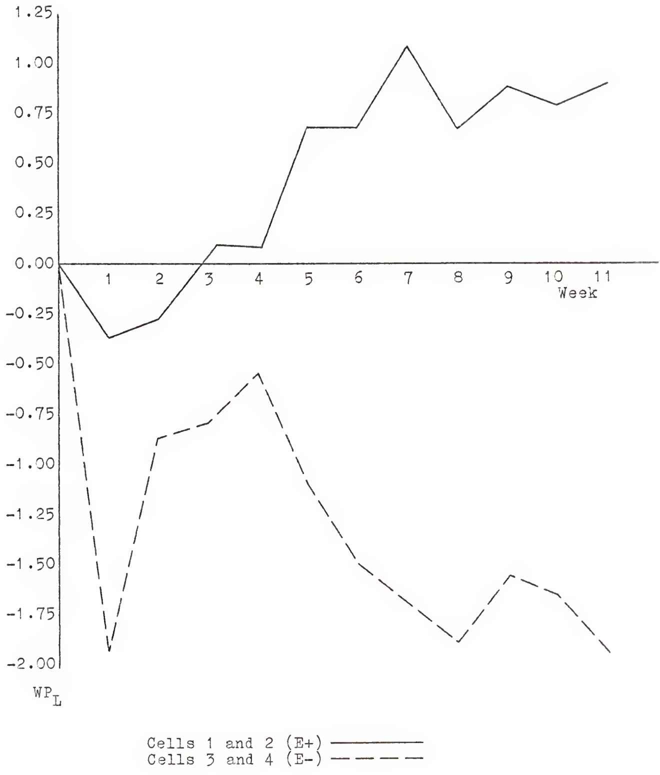


Figure 4-4
Cumulative Residual Statistics (WP_L) of the Experimental Portfolios Partitioned on Mean Earnings Shift

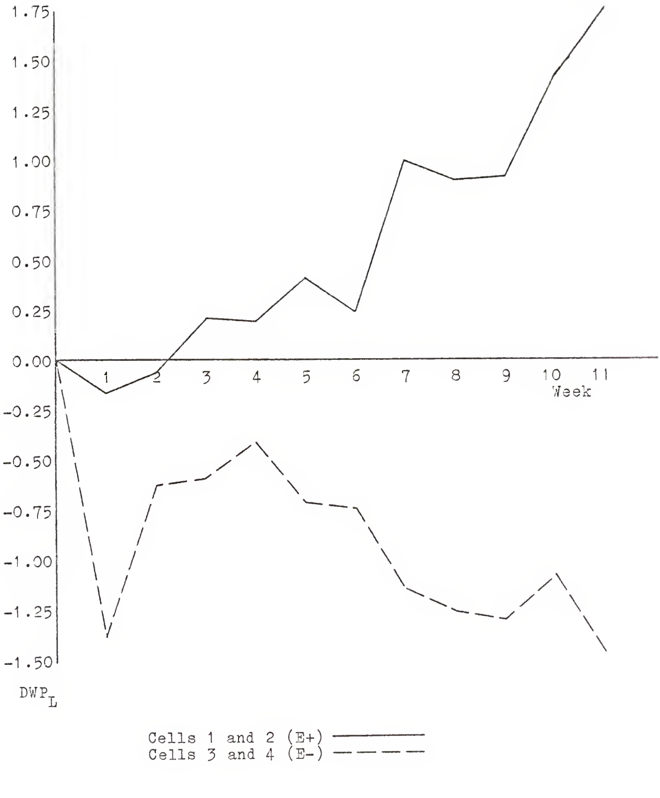


Figure 4-5
Cumulative Residual Statistics Differences (DWP_L) Between Experimental Portfolios and Control Group One Partitioned on Mean Earnings Shift

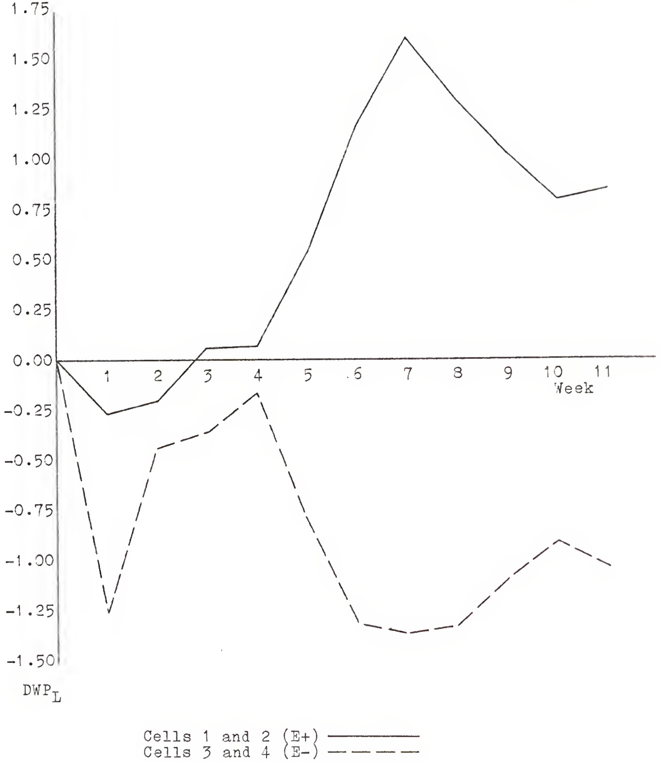


Figure 4-6
Cumulative Residual Statistics Differences (DWP$_L$) Between Experimental Portfolios and Control Group Two Partitioned on Mean Earnings Shift

Table 4-14

Student's t Statistic and Significance Levels for Differences in Group Means of the Cumulative Standardized Residuals Between Positive Earnings Shift Firms (E+) and Negative Earnings Shift Firms (E-)

Experimental Set Used	Week	Calculated Student's t	One-Tailed Significance Level
Experimental Firms Only	7	2.52	0.01
	11	2.41	0.01
Controlled By Control Group One	7	1.99	0.03
	11	2.87	0.01
Controlled By Control Group Two	7	2.84	0.01
	11	1.85	0.03

this analysis, week 7 results are presented to ensure against the potentiality of all effects occurring subsequent to the announcement. The graphic representations support the above behavior consistently throughout the test period. Thus, not only is the earnings effect documented, but the validity of this reduced data set is verified with respect to earlier studies.

The risk effect is the second dimension analyzed. The VP's and WP's for the non-controlled analysis are presented numerically in Table 4-15 and graphically in Figure 4-7. Results adjusted for control groups 1 and 2 are presented in Tables 4-16 and 4-17 and in Figures 4-8 and 4-9. In each case, the final WP (or DWP) statistic for the decreasing risk shift portfolio indicates higher returns in comparison to the increasing risk shift portfolio. The difference is 1.09 (the Z statistic is 0.77) in the non-controlled analysis. In the controlled analysis, the differences are 0.89 and 1.05 (the Z statistics are 0.63 and 0.74) after adjusting for control group 1 and control group 2 respectively.

Although these differences are in the predicted directions, the magnitude is not sufficient for a strong rejection of the null hypothesis. This lack of support for rejection of the null using the partitioned approach is made evident in Table 4-18. Again, the hypothesis

Table 4-15

Residual Statistics (VP_k) and Cumulative Residual Statistics (WP_L) of the Experimental Portfolios Partitioned on Risk Shift

Partition Assignments

WEEK	Cells 1 & 3 (R-)		Cells 2 & 4 (R+)	
	VP_k	WP_L	VP_k	WP_L
1	-0.11	-0.11	-2.14*	-2.14*
2	-0.43	-0.39	1.09	-0.75
3	1.01	0.27	-0.57	-0.94
4	0.21	0.34	0.07	-0.78
5	-0.53	0.07	0.47	-0.49
6	-0.37	-0.09	-0.69	-0.72
7	0.29	0.03	0.10	-0.63
8	-0.69	-0.22	-1.16	-1.00
9	0.54	-0.03	0.90	-0.65
10	0.25	0.05	-0.81	-0.70
11	-0.07	0.03	-0.76	-1.06

* Significant at the 0.05 level

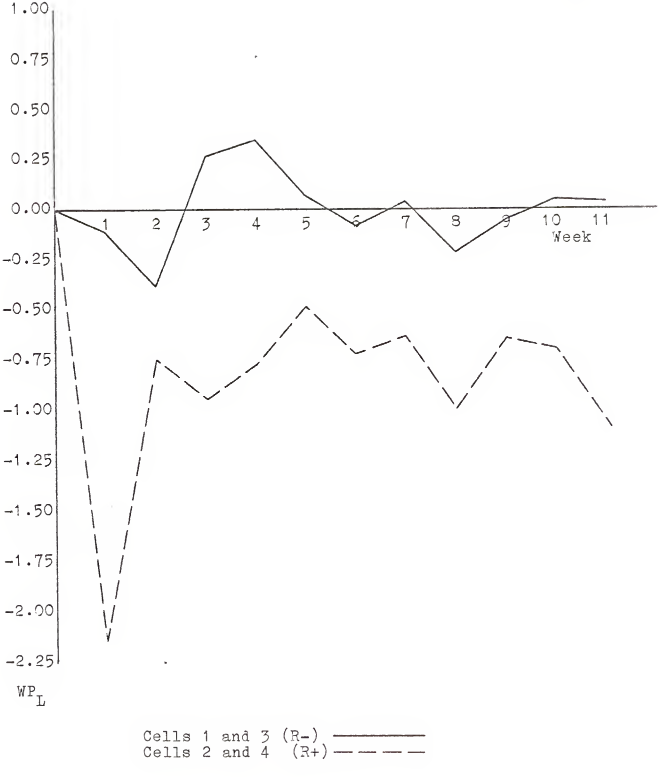


Figure 4-7
Cumulative Residual Statistics (WP_L) of the
Experimental Portfolios Partitioned on Risk Shift

Table 4-16

Residual Statistics Differences (DVP_k) and Cumulative Residual Statistics Differences (DWP_L) between Experimental Portfolios and Control Group One Partitioned on Risk Shift

Partition Assignments

WEEK	Cells 1 & 3 (R-)		Cells 2 & 4 (R+)	
	DVP_k	DWP_L	DVP_k	DWP_L
1	-0.08	-0.08	-1.43	-1.43
2	-0.29	-0.27	0.81	-0.43
3	0.69	0.18	-0.32	-0.54
4	0.14	0.22	0.04	-0.45
5	-0.55	-0.04	0.31	-0.26
6	-0.22	-0.13	-0.33	-0.37
7	0.32	0.00	0.50	-0.16
8	0.40	0.14	-0.96	-0.49
9	-0.23	0.05	0.05	-0.44
10	1.52	0.53	0.72	-0.19
11	0.29	0.60	-0.36	-0.29

Table 4-17

Residual Statistics Differences (DVP_k) and Cumulative Residual Statistics Differences (DWP_L) between Experimental Portfolios and Control Group Two Partitioned on Risk Shift

Partition Assignments

WEEK	Cells 1 & 3 (R-)		Cells 2 & 4 (R+)	
	DVP_k	DWP_L	DVP_k	DWP_L
1	-0.05	-0.05	-1.44	-1.44
2	-0.26	-0.22	0.83	-0.43
3	0.74	0.24	-0.31	-0.53
4	0.18	0.30	0.15	-0.38
5	-0.21	0.17	-0.21	-0.44
6	0.40	0.32	-0.15	-0.46
7	1.02	0.69	0.00	-0.43
8	-0.66	0.41	-0.09	-0.43
9	0.56	0.57	0.02	-0.39
10	-0.40	0.41	-0.45	-0.52
11	0.15	0.44	-0.37	-0.61

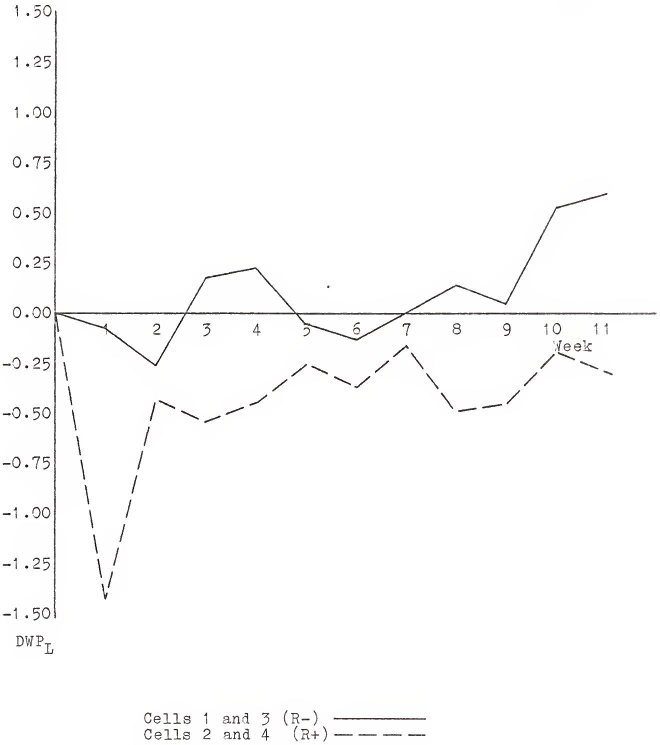


Figure 4-8
Cumulative Residual Statistics Differences (DWP_L) Between Experimental Portfolios and Control Group One Partitioned on Risk Shift

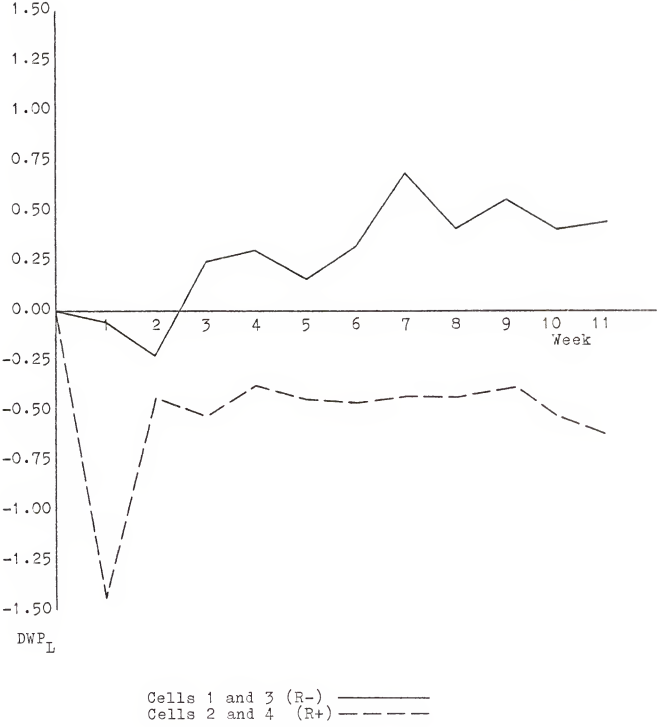


Figure 4-9
Cumulative Residual Statistics Differences (DWP_L) Between Experimental Portfolios and Control Group Two Partitioned on Risk Shift

Table 4-18

Student's t Statistic and Significance Levels for Differences in Group Means of the Cumulative Standardized Residuals Between Decreasing Risk Shift Firms (R-) and Increasing Risk Shift Firms (R+)

Experimental Set Used	Week	Calculated Student's t	One-Tailed Significance Level
Experimental Firms Only	7	0.55	0.29
	11	0.86	0.20
Controlled By Control Group One	7	0.14	0.44
	11	0.74	0.23
Controlled By Control Group Two	7	1.00	0.16
	11	1.00	0.16

tested is that of no difference between group means. Neither the week 11 comparison nor the week 7 comparison offers any reasonably strong basis for rejection of the null hypothesis. However, inspection of the pattern of the WP (and DWP) statistics indicates that the risk decreasing portfolio does dominate the risk increasing portfolio at all points over the test period. This provides an element of support to a rejection of the null hypothesis, PHo_2, in favor of the specified alternative. However, based on the above results, this must be considered a weak rejection.

Finally, certain apparently anomalous results are addressed. Given that public information is efficiently processed by the market, the period following the forecast week should be uneffected by the forecast information and a normal return pattern should be exhibited. Tables 4-7 and 4-12 present some interesting results in light of this situation. Two of the 20 VP statistics from the post-forecast portion of the test period (week 7 through week 11) attained a value greater than 1.65 (significance level of 0.05) in Table 4-7, while two of the ten VP's during the same period attained the same level on Table 4-12. In each of the above cases, this large post-forecast stock price behavior occurs in a manner which increases the likelihood of rejecting the null hypothesis. Even so, analysis of the cumulative residuals

as of week 6 on both of these tables still shows results which exhibit a relationship between cells consistent with the direction of the alternative hypotheses. Furthermore, of the remaining seven tables of residuals, only one occurence is noted of a post-forecast VP statistic equal to or greater than 1.65 (that in Table 4-5, week 11, Cell 4). However, if the analysis relevant to Table 4-5 were terminated as of week 10 instead of week 11, the results of the analysis would not be effected. Finally, both tables which present these anomalous statistics (4-7 and 4-12) reflect the impact of control group one. It is possible that the post-forecast behavior noted is a result of strong and unusual price behavior in a portion of the control group, particularly when the small sample size is considered. This possibility is supported by the consistency of the results between the non-controlled experimental statistics and those controlled by control group two.

A high degree of consistency exists between the regression results and the partitioned results except with regard to the significance level of the risk shift variable. It should be noted, however, that the investigation of the null hypothesis PHo_2 used a different perspective than that in the case of RHo_2. First, the regression approach utilized all of the information in the independent variables as opposed to the partitioned

approach which utilized the sign effects alone. This aspect could be a partial contributor to the observed differences in results. Additionally, in a multiple regression setting, the impact of any given independent variable is determined in concert with the effects of the other independent variables. In this way the regression tests of the risk shift parameter control for the effect of the expected earnings shift parameter. (The same can be said for the tests of RHo_1.) This aspect of controlling for the potentially confounding effects of the other independent variable is not available in the partitioned analysis of the individual independent variables. It may be that in controlling for the expected earnings shift effect, the risk shift effect is more clearly delineated. This offers another possible reason why the results attained in the regression analysis are stronger than those observed in the partitioned analysis.

CHAPTER V
SUMMARY AND CONCLUSIONS

The purpose of this study was to investigate the information content of management forecasts. The main focus was on the extent to which mean earnings shifts and risk shifts accompanying the forecast were associated with predictable security price patterns. This study differs from previous studies in two ways. First, and principally, the incorporation of the risk shift parameter, as measured by the Black-Scholes Options Model, allowed the specification of a complete set of dimensions from a classical finance perspective (risk and return) for investigating security price behavior. Secondly, the impact of the earnings expectation shift (tested in previous studies and validated in this study), as well as the risk shift, was measured in terms of both the sign and the magnitude of these variables.

The experimental sample consisted of fifty management forecast releases made over the years 1974 through 1979. For each firm, the standardized cumulative residual was calculated over the test period along with the expected earnings shift metric and the risk shift metric. An

ordinary least squares regression of the expected earnings shift and the risk shift on the final cumulative residual statistic was performed. The statistical analysis provided strong support to the rejection of the null hypotheses in favor of the predicted relationships for both independent variables. It was also noted that the earnings and risk effects explained between twelve and twenty-two percent of the variability in the final cumulative residuals, thereby indicating a reasonably significant level of explanatory power in these two variables.

As the partitioned approach to this type of investigation has been traditionally followed, that approach was implemented for supplementary purposes. On the basis of the expected earnings shift metric and the risk shift metric, firms were classified into one of four portfolios; Cell 1, Cell 2, Cell 3, and Cell 4. An investigation of the portfolio abnormal security returns for each of the four portfolios supported the hypothesis that positive abnormal returns would accompany the favorable portfolio (Cell 1), negative abnormal returns would accompany the unfavorable portfolio (Cell 4), while the mixed news portfolios would generate results between the favorable and unfavorable portfolios. A separate analysis of each dimension was conducted to ensure that both dimensions were contributing to this effect. The

earnings shift variable showed strong significant effects in the individual parameter investigation while the risk shift variable, though consistent in the direction of the results, was not significant. The inability of the partitioned analysis to detect an impact with regard to the risk shift variable underscores the possibility that, in an effort to minimize measurement errors by use of a partitioned analysis, valuable information may be lost. Such information, when incorporated into the analysis through a regression approach, may indicate the existence of relationships undiscernible through partitioned analysis.

Any conclusions presented in this study should be tempered with an awareness of the following considerations. First, a small sample size was used and that sample was drawn from firms traded on an organized options exchange. All firms were listed on the New York Stock Exchange (NYSE). As such, the sample represents large surviving firms and may not be representative of smaller or non-optionable firms. Secondly, an additional bias may be introduced in that the sample firms must have been firms in which security analysts have exhibited an interest.

Finally, the risk measure used in this study relies on a model to which numerous adjustments have been proposed in the finance literature. As such, it must be

viewed as a rough estimate of the desired property to be measured. This consideration is heightened by the use of Barrons as a source of data for options and stock quotes. Firms listed on the NYSE and the Chicago Options Exchange would experience a timing difference in the final quote of the day and thus the data used in this analysis may be subject to measurement error in this timing difference. In addition, where interest rate term-structure effects exist, the theoritically appropriate risk-free rate should have a duration equal to that of the option. The use of 90 day treasury bill rates for all options may have induced some spurious effects.

This study provides support for the contention that risk shifts accompanying a forecast release are a relevant security pricing variable in addition to shifts in the earnings expectations. Additional research related to this question might include the following questions:

1. Is it possible to make reasonable predictions, based only on a knowledge of the forecast number and other public information, of the direction and magnitude of a forecast related risk shift?
2. Given that such a prediction model could be developed, would it be useful in classifying the forecasts of non-optionable firms as risk increasing or risk decreasing?

The first question would involve additional analysis of

the forecasts in the current data set while the second analysis would basically entail a replication of the current study using a data set of non-optionable firms classified according to the relationship formulated in investigating the first question. If this were found to be the case, research incorporating the risk shift aspect could begin to be conducted on firms outside of the limited population of optionable firms. The expanded potential data set would provide a base for greater generalizability of any results attained.

APPENDIX A
EXPECTED UTILITY OF A QUADRATIC UTILITY FUNCTION

Generally, a quadratic utility function can be written as a second degree polynomial as:

$$U(r) = a + br + cr^2 \tag{1}$$

Since a utility function is defined up to a linear transformation, the constant, a, can be subtracted from both sides of the equation. Both sides can then be divided by b without changing the investor's preference order. The result is

$$U(r) = r + Br^2 \tag{2}$$

For a risk averse investor, $B < 0$.

To show the connection between expected utility and the mean and variance, $E(r)$ and $var(r)$ are defined as:

$$E(r) = \sum_{i=1}^{N} p_i r_i \tag{3}$$

$$\begin{aligned} var(r) &= \sum p_i (r_i - Er)^2 \\ &= \sum p_i r_i^2 - (p_i r_i)^2 \end{aligned}$$

$$var(r) = E(r^2) - [E(r)]^2 \tag{4}$$

Expected utility is defined as:

$$EU(r) = \sum p_i U(r_i) \qquad (5)$$

Substituting equation (2), the following attains:

$$EU(r) = \sum p_i \ (r_i + Br^2)$$

$$= \sum p_i r_i + B \ \ p_i r_i{}^2$$

$$= \ E(r) + B \ E(r^2) \qquad (6)$$

Equation (4) can be restated as:

$$E(r^2) = var(r) + [E(r)]^2 \qquad (7)$$

Equation (7) can be substituted into equation (6) resulting in expected utility being stated as a function of both E(r) and var(r) as follows:

$$EU(r) = Er + B \ [[E(r)]^2 + var(r)]$$

$$= Er + B \ [E(r)]^2 + B \ var(r) \qquad (8)$$

With a negative value for B, and considered only up to a point of inflection, this function indicates increasing utility of wealth and decreasing utility of risk.

APPENDIX B
CONTROLS USED WHEN CONVERTING DATA TO MACHINE READABLE FORM

Since a large volume of options data was collected for this dissertation (over 19,000 option prices were collected along with other data required by the options model), and it was not originally in machine readable form, a series of procedures were implemented to minimize coding and transcription errors.

1. All raw data was collected by hand and transcribed to pre-printed coding sheets.
2. The data was keypunched and verified by trained and experienced keypunch operators.
3. All machine readable data was inputed to a computer program which checked for:
   - a- reasonable dividend return figures
   - b- reasonable option prices relative to the spread between the striking price and the stock price
   - c- option prices recorded in the correct increment

d- stock prices recorded in the correct increment

e- correct expiration month (the month name and number were recorded and then compared to both validate the transcription process and to ensure that options expiration months occurred in three month cycles)

4. The time until the expiration of an option was not hand calculated (except for check purposes) but was generated by a separate program which incorporated a special calendar of expiration dates for each month (all options in a given month expire on the same day) and the time until the expiration for each of the weeks over the preceding ten month period.
5. Finally, after all data was sorted by firm and by week within firm, it was visually inspected and some residual errors not detected in the previous steps were identified and corrected.

Although some errors may still exist, it is hoped that the above procedures reduced the error rate to an immaterial level.

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BIOGRAPHICAL SKETCH

Michael Gift was born on April 10, 1949, in Allentown, Pennsylvania. His first 18 years were largly spent in the Lehigh Valley area of Pennsylvania. He received a Bachelor of Science degree from Shippensburg State College in 1974. Mr. Gift graduated with honors with a major in business administration, concentration in accounting. This undergraduate program had been interrupted from 1968 through 1971 while Mr. Gift was on active duty with the United Stated Army.

In the Spring of 1974, Mr. Gift joined the audit staff of Arthur Andersen & Company in Hartford, Connecticut. However, he resigned this position a year later to pursue an MBA degree at Shippensburg State College. After completing this degree in May, 1976, he moved to Gainesville, Florida, to study for the degree of Doctor of Philosophy at the University of Florida.

While enrolled in the graduate program at the University of Florida, Mr. Gift earned his livelihood in many ways. Primarily, he was employed by the university as a graduate research/teaching assistant during which time he worked for Professors Rashad Abdel-kahlik and

Bipin Ajinkya. He was also employed as a systems advisor for the College of Engineering, University of Florida; a writer for Totaltape, Inc. (developing CPA review material); and consultant to and Vice-President of Finance for J. P. Schmitt and Associates, Inc. (a Gainesville based risk management firm). In early 1982, Mr. Gift and his family relocated to Bloomington, Indiana, where he has been employed as a Convertible Lecturer of Accounting at Indiana University. During this period he completed the work on this dissertation.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

A. R. Abdel-Khalik

A. Rashad Abdel-khalik, Chairman
Graduate Research Professor of Accounting

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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Associate Professor of Accounting

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Richard Pettway
Professor of Finance and Insurance

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Raymond Chiang
Assistant Professor of Finance and Insurance

This dissertation was submitted to the Graduate Faculty of the School of Accounting in the College of Business Administration and to the Graduate Council, and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

April, 1983

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Dean for Graduate Studies
and Research